22. A. 6

BOSTON
MEDICAL LIBRARY
8 THE FENWAY

Digitized by the Internet Archive
in 2011 with funding from
Open Knowledge Commons and Harvard Medical School

http://www.archive.org/details/therapeuticsmate01stil

THERAPEUTICS

AND

MATERIA MEDICA.

HOC SUM CONTENTUS QUOD, ETIAMSI QUOMODO QUIDQUE FIAT IGNOREM, QUID FIAT INTELLIGO. . . . QUID SCAMMONEÆ RADIX AD PURGANDUM, QUID ARISTOLOCHIA AD MORSUS SERPENTUM POSSIT, VIDEO: QUOD SATIS EST; CUR POSSIT NESCIO.

CICERO, *De Divinatione.*

Geo. B. Shattuck
from the author Nov. 1874

THERAPEUTICS

AND

MATERIA MEDICA.

A SYSTEMATIC TREATISE

ON THE

ACTION AND USES OF MEDICINAL AGENTS,

INCLUDING THEIR

DESCRIPTION AND HISTORY.

BY

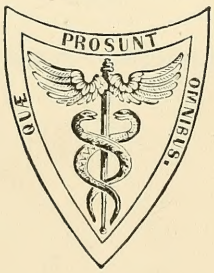
ALFRED STILLÉ, M.D.,

PROFESSOR OF THE THEORY AND PRACTICE OF MEDICINE AND OF CLINICAL MEDICINE IN THE UNIVERSITY OF PENNSYLVANIA; PHYSICIAN TO ST. JOSEPH'S HOSPITAL; FELLOW OF THE COLLEGE OF PHYSICIANS, AND MEMBER OF THE PATHOLOGICAL SOCIETY OF PHILADELPHIA; CORRESPONDING FELLOW OF THE NEW YORK ACADEMY OF MEDICINE; MEMBER OF THE SOCIÉTÉ MÉDICALE D'OBSERVATION, OF PARIS; HONORARY MEMBER OF THE MEDICAL SOCIETIES OF THE STATES OF RHODE ISLAND, NEW YORK, AND CALIFORNIA, ETC. ETC.

FOURTH EDITION, THOROUGHLY REVISED AND ENLARGED.

IN TWO VOLUMES.

VOL. I.



PHILADELPHIA:
HENRY C. LEA.
1874.

BOSTON MEDICAL
MAY 29 1930
LIBRARY

22 A87

Entered according to the Act of Congress, in the year 1874, by

HENRY C. LEA,

in the Office of the Librarian of Congress. All rights reserved.

PHILADELPHIA:
COLLINS PRINTER,
705 Jayne Street.

I DEDICATE

THE FOURTH EDITION OF

THIS WORK

TO

Francis Gurney Smith, M.D.,

PROFESSOR OF THE INSTITUTES OF MEDICINE IN THE UNIVERSITY OF PENNSYLVANIA,

MY FRIEND FOR MORE THAN THIRTY YEARS,

AND DURING MOST OF THAT TIME

MY COLLEAGUE IN MEDICAL TEACHING,

AS A

MARK OF MY RESPECT

FOR

HIS WELL-EARNED DISTINCTION AS A TEACHER AND PRACTITIONER OF MEDICINE,

AND OF

MY AFFECTION FOR HIS PERSON AND CHARACTER.

PREFACE TO THE FOURTH EDITION.

For more than two years this work has been out of print, and the author regrets that circumstances beyond his control prevented the publication of a fourth edition of it at an earlier day. He trusts that the delay will have tended to render the present issue worthy of even greater favor than the previous ones enjoyed. It has given him time for a careful revision of the whole work, and the addition of about two hundred and fifty pages of new matter. Several new articles have been introduced, the chapter on Electricity has been almost entirely rewritten by Dr. Mathew J. Grier, and the nomenclature throughout been made to conform to the last edition of the Pharmacopœia. The original classification of medicines has been retained, not because it is presumed to be perfect, but because the author, after a careful examination of more recent systems, has been compelled to conclude that they are less natural and less practical. In the first edition of the work he contended against the mischievous error of seeking to deduce the therapeutical uses of medicines from their physiological action. Continued study, observation, and reflection have tended to strengthen his convictions upon this subject, and to confirm him in the faith that clinical experience is the only true and safe test of the virtues of medicines.

3900 Spruce St., Philadelphia,
October, 1874.

PREFACE TO THE FIRST EDITION.

Some years have elapsed since the present work was undertaken and announced, but its completion has been delayed by several causes, the chief of which were the author's election to the chair of Theory and Practice of Medicine in the Medical Department of Pennsylvania College, and the onerous duties which that office imposed upon him during a period of five years. The studies which they rendered necessary have tended greatly to enlarge the original plan of his treatise, and have also, it is hoped, rendered it more worthy than it would otherwise have been of a favorable reception by physicians and students of Medicine. Intended for those who desire to learn the surest methods of curing disease, it has seemed not only allowable, but imperative, that in the form of the work scientific unity and precision should be subordinated to practical utility. At the same time, it would have been unpardonable to leave out of sight those fragments of scientific knowledge which may one day serve to bridge the chasm between theory and practice, and convert the precepts of therapeutics into laws.

The strictly scientific portion of the subject embraces the consideration of medicines in their physical, chemical, and physiological relations. Of these the first and second are described so fully and accurately in works which rank among medical classics, that it seemed unnecessary to discuss them at length in a treatise whose point of view is rather at the bedside of the sick than in the laboratory or the lecture-room. On the other hand, the action of medicines upon the sound organism of man and of the lower animals forms an indispensable key to their curative operation in disease. The more thoroughly it is known, the more intelligible must the mode become in which medicines bring about the restoration of soundness of structure and function, and the more will the isolated facts of therapeutics tend to arrange themselves in a systematic form. If this division of the subject is more copiously illustrated than is usual in treatises on the Materia Medica, it may perhaps the better serve to aid the sagacious reader in explaining the operation of remedies, and to suggest new occasions for their employment.

Our knowledge of the usefulness of medicines rests altogether upon

experience, but not upon that of any one man, however skilful, or of any age, however enlightened; their efficacy is attested by a multitude of witnesses, and is confirmed by time, which reduces the opinions of individuals to their just value, outlives the fashions of the day, and is unmoved by the prejudices of the schools. To experience, then, we must turn as the ultimate and decisive arbiter of all questions respecting the curative virtues of medicines, feeling assured that whenever the particular application of a remedy can be sustained by the testimony of the great physicians of successive ages, our employment of it possesses the highest possible sanction. In this conviction, the reader of the present work will, it is hoped, find a motive and a justification for the citations and references with which it abounds. It would have been a lighter task, by far, to rest the recommendation of particular remedies and methods of cure upon principles deduced, with more or less plausibility, from their supposed mode of action, and from the intimate pathological conditions for the removal of which they are presumed to be adapted. But as all such principles, when brought to the test of experience, have proved fallacious or insufficient, it was judged that a laborious comparison of actual results would compensate by its real utility for the exclusion of speculations which tend more to gratify an author's vanity, and flatter the reader's fancy, than to promote sound learning or render the treatment of disease more intelligible and successful. It is, indeed, impossible, in such a work, to present in detail the observations, or even the conclusions, of medical writers; and therefore, while it has been attempted to furnish a truthful, although a succinct, account of both, numerous references to original sources of information are provided for those who desire to prosecute the investigation. These consist of ancient classical authorities, and modern writers of the highest reputation in the Italian, French, German, and English languages, whose observations have been preserved in special essays, or in that great repository of facts, the periodical literature of the present century. It seemed as if a treatise executed in so catholic a spirit, and with no conscious bias towards any sect or school, ought to contain a large proportion of solid and useful truth; but as the author is far from presuming that he has fully accomplished his design, he craves the reader's indulgence for the shortcomings of his work, in favor of the spirit which inspired it.

PHILADELPHIA, *January*, 1860.

CONTENTS OF VOLUME I.

INTRODUCTION.

	PAGE
Sources from which medicines are derived	19
Sources of knowledge and limits of power in therapeutics	20
Sources of knowledge respecting the action of medicines	28
The physiological action of medicines	38
The local action of medicines	39
The remote action of medicines	40
Absorption	45
The avenues by which medicines are introduced, and the effects which they produce	54
The curative action of medicines	79
Influences modifying the effects of medicines	86
The administration of medicines	96
The art of prescribing	101
Classification of medicines	104

CLASS I. LENITIVES.

Lenitives in General	107
Mucilaginous Lenitives	112
Acacia	112
Althæa	114
Cetraria	115
Chondrus	117
Linum	118
Salep	120
Sassafras Medulla	121
Sesamum	121
Tragacantha	122
Ulmus	123
Amylaceous Lenitives	124
Amylum	124
Avenæ Farina	125
Hordeum	126

PAGE

Maranta 127
Oryza 128
Sago 129
Tapioca 129

FATTY AND OLEAGINOUS LENITIVES 131

Adeps 131
Amygdala Amara; Amygdala Dulcis 132
Cetaceum 136
Glycerina 137
Olea Fixa 143
Oleum Olivæ; Oleum Amygdalæ; Oleum Theobromæ . . 143
Sevum 144

GELATINOUS LENITIVES 144

Gelatina 144
Ichthyocolla 145
Collodium 146

SACCHARINE LENITIVES 151

Glycyrrhiza 151
Mel 152
Saccharum 155

CLASS II. ASTRINGENTS.

ASTRINGENTS IN GENERAL 163

MINERAL ASTRINGENTS 171

Alumen 171
Bismuthi Subnitras; Bismuthi Subcarbonas 183
Cerium, Oxalate of 191
Plumbum 192
Zinci Acetas 218
Zinci Carbonas Præcipitata 219

VEGETABLE ASTRINGENTS 220

Acidum Tannicum 220
Acidum Gallicum 228
Catechu 231
Galla 233
Geranium 234
Hæmatoxylon 235
Kino 236
Krameria 238
Quercus Alba; Quercus Tinctoria 242
Rosa Gallica 244
Rubus 245

CLASS III. IRRITANTS.

PAGE

Irritants in General 247

Irritants, chiefly from the Mineral Kingdom . . . 264

Acidum Aceticum; Acidum Aceticum Dilutum; Acetum; Acetum Destillatum 264
Acidum Nitricum; Acidum Nitricum Dilutum . . . 271
Chlorinium; Aqua Chlorinii 276
Liquor Sodæ Chlorinatæ 282
Calx Chlorinata; Calcii Chloridum; Liquor Calcii Chloridi . . 285
Acidum Muriaticum 292
Acidum Nitro-Muriaticum; Acidum Nitro-Muriaticum Dilutum . 295
Acidum Chromicum 297
Acidum Sulphuricum; Acidum Sulphuricum Dilutum; Acidum Sulphuricum Aromaticum; Acidum Sulphurosum . . . 299

Irritants, chiefly Alkaline and Saline 307

Aqua Ammoniæ Fortior; Aqua Ammoniæ; Spiritus Ammoniæ; Spiritus Ammoniæ Aromaticus 307
Potassa; Potassa cum Calce; Liquor Potassæ; Potassii Carbonas; Potassii Carbonas Pura 317
Sodii Carbonas; Sodii Carbonas Exsiccata; Sodii Bicarbonas . 327
Sodii Boras 336
Calx; Aqua Calcis; Calcii Carbonas Præcipitata; Creta Præparata 340
Lithii Carbonas; Lithii Citras 349
Potassii Permanganas 351
Sodii Sulphis; Potassii Sulphis; Acidum Sulphurosum . . 354
Argenti Nitras 360
Cupri Sulphas 384
Zinci Chloridum 388

Vegetable Irritants 392

Sinapis Alba; Sinapis Nigra 392
Capsicum 399
Pix Burgundica 402
Petroleum 404
Mezereum 406
Pyrethrum 411
Sabina 411
Monarda 416

Animal Irritants 417

Cantharis 417

CLASS IV. TONICS.

PAGE

Tonics in General 446

Specific Tonics 451

Ferrum 451
Cinchona 491
Salix 551
Cornus Florida 553
Nectandra 555
Prunus Virginiana 557

Simple Bitter Tonics 560

Calumba 562
Gentiana 564
Quassia 566
Sabattia 569
Chiretta 569
Coptis 570
Xanthorrhiza 571

Stimulant Tonics 571

Anthemis 572
Eupatorium 575
Angustura 578
Cascarilla 579
Marrubium 581
Achillea 582
Calamus 584
Aurantii Amari Cortex ; Aurantii Dulcis Cortex . . . 585
Angelica 587

Tonic and Aromatic Stimulants 588

Anisum 591
Asarum 592
Oleum Cajuputi 592
Cinnamomum 593
Canella 596
Caryophyllus 597
Cardamomum 598
Carum 599
Coriandrum 600
Fœniculum 601
Gaultheria 602
Hedeoma 603
Lavandula 604
Melissa 605
Myristica 606

PAGE

Macis 606
Mentha Piperita 608
Mêntha Viridis 609
Monarda 610
Pimenta 611
Piper 611
Rosmarinus 615
Ruta 616
Salvia 620
Sambucus 623
Zingiber 624

CLASS V. GENERAL STIMULANTS.

General Stimulants 628

Calor 634
Electricity 655
Oxygen 703
Vinum Portense; Vinum Xericum 710
Alcohol 723
Oleum Terebinthinæ 753
Creasotum 767
Acidum Carbolicum 774
Ammonii Carbonas 783
Arnica 791
Toxicodendron 795
Phosphorus and the Hypophosphites 798

CLASS VI. CEREBRO-SPINAL STIMULANTS.

Cerebro-Spinal Stimulants in General 804

Narcotics 805

Opium 810
Lactucarium 883
Hyoscyami Folia; Hyoscyami Semen 887
Belladonnæ Folia; Belladonnæ Radix 897
Stramonii Folium; Stramonii Semen 931
Humulus 943
Dulcamara 948
Cannabis Indica; Cannabis Americana 955

HARVARD UNIVERSITY
LIBRARY

BOSTON MEDICAL
MAY 29 1930
LIBRARY

THERAPEUTICS

AND

MATERIA MEDICA.

INTRODUCTION.

MEDICINES are substances used for the CURE OF DISEASES.

In the natural sciences which treat of living organized structure, an absolute definition of terms is impossible. This statement is eminently true of medicine—the most complex of all sciences, and the only one whose peculiar province it is to investigate the laws of processes which are themselves departures from law.

If those substances only which are exclusively appropriated to the treatment of disease were included among medicines, the number of the latter would be greatly diminished. But many are employed in the arts, as the metals and their compounds; many are used for food, as sugar, alcohol, albumen, fat, gelatin, oil, etc.; many as condiments, as salt, saltpetre, pepper, mustard, vinegar, garlic, etc. In all of these, and in a thousand similar cases, the medicinal use of a substance is secondary and subordinate to that by which it stands related to the healthy organism. In some sense, even, all food is medicinal, for it counteracts hunger, the first symptom of a disease which tends directly to death.

A large number of substances are used as medicines, and for no other purpose, whose qualities are not inaptly represented by the popular idea that a medicine is something which is offensive to the senses or distressing in its operation. All of the bitter medicines belong to this class; and many, also, which by their very antagonism to the economy, excite its various organs to unwonted efforts, or restrain their excessive action, and thus become salutary in their effects. Among these we may rank emetics, purgatives, narcotics, etc. So powerful is their action, in many cases, that, if administered in larger quantities than experience warrants, they may become poisons instead of medicines.

There is no natural difference between a *medicine* and a *poison*. All medicines are not poisons, nor is every poison necessarily a

medicine. But, with scarcely an exception, substances which, in a certain dose, are capable of destroying life, are also, in a certain less amount, adequate to save life. Their deleterious action is only an excess of their salutary action; and, generally, the former is proportioned to the latter. In this, medicines obey a general law under which every capacity for good is equally a capacity for evil. Light and heat, the vivifiers of the universe, would become the most powerful agents in its destruction were their operation uninterrupted and intense.

The illustration which has just been made use of suggests, further, the remark that there is a difference between a *medicine* and a *remedy*, in that the latter is the more comprehensive term. Light, mental influences, exercise, and diet, which are powerful remedies in certain diseases, are never included in the catalogue of medicines; while heat and electricity, which belong to the same class of natural agents as light, enjoy that distinction. Considered as material agents, they may, without impropriety, be comprised in the definition which has been given of a *medicine*.

Most of the natural agents just named are employed to prevent rather than to cure disease, and hence belong to the domain of *Hygiene* rather than to that of the Materia Medica. The simple reference that has been made to them is sufficient to show that, to limit the resources of the physician to the use of drugs alone, is to adopt a very narrow view of the importance of his office.

There are still other remedies which are not medicines. The instruments and apparatus employed in surgery and obstetrics illustrate this statement. Their office is to afford nature a *mechanical* assistance in the performance of her functions.

Materia Medica, or Pharmacology, treats of the natural history and the preparation of medicines, and of their operation on the animal economy. It strictly includes Pharmacy, or the art of selecting, preparing, and compounding medicines; but this, which belongs to the apothecary as his special business, should occupy only a subordinate position in a treatise which is addressed to the physician and the student of medicine.

Therapeutics treats of the *action* and the *uses* of medicines in the cure of disease. It is *general* and *special*. *General Therapeutics* investigates the relations of medicines to disease in general, or of classes of medicines to morbid states which are common to several diseases. *Special Therapeutics* considers the application of individual remedies to the cure of particular diseases or symptoms. In works which treat of the whole subject, the former division is discussed in chapters prefixed to the several classes of medicines, and the latter in connection with the several articles of the Materia Medica.

Works on Therapeutics are complementary to works on the Practice of Medicine. In the latter, many remedies are examined from the point of view of a single disease; in the former, many diseases are examined in their relations to a single remedy. Either would be incomplete without the other, and he is the best practitioner of medicine who most constantly and clearly keeps before his mind

the reciprocal dependence of the two great departments of the Art of Healing.

Sources from which Medicines are derived, and the Causes which modify their Virtues.—Medicinal substances are furnished chiefly by the vegetable, mineral, and animal kingdoms. They derive their virtues from active principles, each of which possesses a uniform composition, however variously it may be associated with other principles, or with inert matter, which modify its operation upon the system. In nature, a medicine seldom exists in a pure or isolated state; and although chemistry has extracted what are called the active principles of many drugs, as quinia from cinchona, and morphia from opium, it has at the same time revealed that nature has associated with these principles certain others which, subordinate though they may be, are probably essential to the effects produced by the drug in its natural state. It is, perhaps, hardly less unwise to expect identical effects from a vegetable alkaloid and from the plant which yields it, than it was at one time to employ gelatin for food, as the representative of meat. In the latter case, nature vindicated her own laws by the disease and even the death of the victims of a short-sighted science; and, in the former, it will probably be found hereafter that the proper representative of a natural drug is a combination, in their due proportion, of all its active constituents. Medicines derived from the mineral kingdom are seldom used in their natural state, nor until they have been isolated from their chemical or mechanical associations, and combined anew in more soluble forms. But the case is different in regard to animal and vegetable productions.

It is a familiar fact, that the immature plant or animal presents but feebly the qualities which distinguish its maturity. The flesh of the young animal is delicate and insipid, while that of the adult may be coarse and rank, and, when the sexual organs have become developed, may afford a medicinal substance which is altogether wanting before this occurrence, and which is most active during the rutting season. The young plant and the recently formed portions of older plants abound in mucilage and other constituents, without active medicinal qualities, while the same parts, on attaining their maturity, furnish some of the most precious drugs, or acquire poisonous properties. The immature shoots of phytolacca (poke) are used as a vegetable for food, but the root of the full-grown plant is an acrid emetic and purgative. The flowers of many plants abound in an essential oil which cannot be procured from any other part.

By far the greatest number of active medicines derived from the vegetable kingdom are products of the torrid zone, or of countries which resemble this region in their temperature. There, the exuberance and vigor of life are extreme, and under the blaze of a tropical sun alone, are elaborated those essential oils which give energy to a large class of medicines, and those narcotic and other principles which mainly affect the nervous system. The plants which furnish

these potent remedies lose half their vigor when transplanted to a colder soil and climate. The hemp, which in Persia exudes a powerfully narcotic and stimulant juice, forms no such product in the colder regions of Europe and the northern United States; and the poppy, which in Turkey abounds in opium of the most active properties, yields a comparatively feeble product when transplanted to the south of France.

Differences of soil involve a diversity of virtues in vegetable products. One rich in organic remains is unsuited to develop the powers of a plant which is natural to a rocky or a sandy soil; and the algæ and mosses which grow by the sea-side have qualities very different from those of the dock and the sweetflag, which thrive in fresh-water lakes and rivers. Differences also in the deeper strata of the earth produce an equally great diversity in the operation of mineral waters, which, in all ages, have been ranked among the most efficient remedies for chronic diseases.

The Sources of Knowledge and the Limits of Power in Therapeutics.

Experience is really, as well as rationally, the only ground upon which curative effects can be expected from medicines. All of the positive knowledge which is now possessed concerning them is the result of an accumulated observation of their effects, in some cases, during thousands of years. It would be curious, and not wholly uninstructive, to inquire how substances, which are not used for food, began to be employed as medicines; whether man himself instinctively resorted to them, or only in imitation of the lower animals, which still devour certain plants when suffering with pain and various complaints.

The difficulty of accounting for the original discovery of medicines is recognized by all nations, and is expressed in the universal belief that the art of using them is a divine gift to man. Undoubtedly, the instinctive cravings which are often manifested in disease must have led the way to an experimental use of many substances resembling in their physical qualities those which were the object of desire; and thus man, who, like the lower animals, experienced instinctive longings, was led by his rational faculty to make experiments, and to compare and analyze the results of his observation. It is not improbable that in proportion as he recedes from civilization, and lives without its artificial desires, his instinct becomes keener and more unerring in its indications. Yet, every day's experience shows that even in civilized life this singular power often possesses great energy. Every one has witnessed the intense desire for cold drinks usual in acute febrile diseases, the craving for acids in scorbutic affections and in some others distinguished by a diminished crasis of the blood, and also the longing for innumerable and widely dissimilar articles of food, many of them disgusting, or in themselves unwholesome, by pregnant females. The chlorotic girl who greedily devours plaster, and chalk, and charcoal, obeys an

internal craving which is often explained by an excessive secretion in the stomach of an acid, which these substances absorb. And, as Albers has remarked, in selecting such articles she is sometimes wonderfully fastidious. He met with children who relished charcoal made from box-wood, but not from oak, soft but not hard chalk, old but not new plaster; and we remember a young lady, of marked chlorotic aspect, whose unnatural appetite could only be satisfied by a certain ferruginous pebble, which she diligently searched for in the gravel-walk of her garden. While it cannot be maintained that instincts, of which these may serve for examples, always afford correct indications, it must still be admitted that they form one of the original sources of knowledge in the treatment of disease.

A still more abundant source is one which implies some degree of rational observation, viz., a study of the processes by which nature effects the cure of diseases, and an attempt to imitate her operations. It must very early have been remarked that certain evacuations, as bleeding, vomiting, purging, sweating, and urination, formed so many means by which diseases are cured; and by instinctively attempting to imitate these processes, man established an art of medicine. The means of accomplishing this purpose were doubtless rude at first, and derived by imitation from the lower animals, or by an accidental experience of the powers of different agents. Thus we may suppose that heat was the first diaphoretic ever employed, because, on many occasions, its power of causing the perspiration to flow was manifest; and, indeed, we find that among savage nations the vapor-bath and other rude methods of sweating still form the leading method of cure. We may presume that the earliest emetics were those by means of which certain animals excite vomiting, or warm water, whose nauseating properties must very soon have been remarked.

But man, as a rational being, could not permanently remain contented with so limited an extent of knowledge; observation, comparison, memory, and tradition, which is the memory of nations, constantly enriched his medicinal resources, and determined more accurately their value. According to his natural genius he gave to his knowledge more or less of a scientific form; and while some races, like the negro and the red man, seem never to have been capable of adding to or developing their original scanty stock, the Caucasian has evolved, from the primary elements common to all mankind, a science and an art of therapeutics of great extent, variety, and usefulness.

Until the time of Galen, who lived in the second century of the Christian era, medicine hardly claimed the rank of a science—or a philosophy, as it was then termed—but contented itself with a diligent observation of nature and the results of experience. These were gathered and preserved by Hippocrates, Theophrastus, Celsus, Dioscorides, and Aretæus, and have continued to be the fountain from which later ages, even to the present time, have drawn their chief supply of therapeutical knowledge. But Galen claimed to

create a science of medicine, in which every practical precept was deduced from some pre-established principle. By his commanding genius and profound knowledge he succeeded, at a time of general decay and feebleness, in imposing the yoke of his dogmas upon the medical profession for thirteen hundred years During this protracted era of mental and material servitude,the primeval stream of science became completely choked by the rubbish of scholastic learning. But since the emancipation of medicine from its thraldom to the Galenical system, it has not often, nor for a long time, nor ever completely, become the slave of any doctrinal creed. For, although systems have succeeded systems, and Paracelsus, and Stahl, Brown, Rasori, and Hahnemann have by turns arrogated to themselves the possession of infallible principles of therapeutics—some in honest but overweening faith, and others in fraud and falsehood—the advance of medicine has scarcely been retarded, for it has, in the main, adhered to observation as the direct road to scientific truth.

Therapeutics, in this respect, differs in no wise from the other natural sciences, which a great philosopher declared to be "founded upon a rational empiricism; that is to say, upon the totality of facts recorded by science, and subjected to the mental processes of comparison and combination."[1] The same writer further tells us that the first step of the empirical process is to collect individual facts, arranging them according to their likeness or unlikeness, and then to add to these facts by experiment, by means of which we are enabled to study phenomena under different and determinate conditions, and thus ultimately to arrive at empirical laws. Such laws form the *principles* of therapeutics. They are nothing more than concise formulæ of the results of experience, and, therefore, when legitimately formed, are as far as possible from standing in opposition to experience. They rest upon a wider basis of experience than it is possible for any individual to possess, and in no other respect do they differ from the conclusions drawn by a single mind from direct and personal observation. But there is another and very objectionable sense in which the phrase "principles of therapeutics" is sometimes used. It is applied to propositions evolved by the application of hypothetical laws of the action of medicines to equally hypothetical pathological conditions. But the changes which a medicine produces in the organism are so imperfectly known, that it may be said, respecting those substances which most certainly cure disease, we are ignorant of their action, even in the healthy body. On the other hand, we know little or nothing of what constitutes disease; that which we do know consisting of physical changes in the body, which are, indeed, the effects of disease, but not disease itself. How, then, we repeat, is it possible to deduce principles of therapeutics from a comparison of the action of medicines, of which we know little, with the intimate morbid actions of the system, of which we know still less? Yet, upon

[1] Von Humboldt, Kosmos.

such an unsubstantial foundation have been built all of the so-called systems of medicine which have been named above, and which have uniformly failed of success whenever they were brought to the test of experience in the hands of men who had no passions to gratify, and no foregone conclusions to sustain.

But it is not a careless or a random experience which is competent to solve the dark and intricate problems of therapeutics. A clear understanding of the terms of any problem is the first and an essential step towards its solution. In the present case there is, upon the one side, man, but not a perfect animal organism. He has come into the world imperfect, with the deformities, the defects, the morbid tendencies of his ancestors; he has grown up under the most varied circumstances of climate, locality, etc., all of which have moulded his physical condition, and developed in him peculiar susceptibilities; he may be the subject of almost innumerable diseases, of various grades, in various combinations, and at different stages, and each one of these modified by his preëxistent tendencies. On the other side there is the medicine, varying in its effects with its origin and mode of preparation, its dose and combination, even in the same healthy organism, but infinitely more so according to the peculiarities of the patient and the disease with which he may be affected. It would seem almost impossible that the product of two such uncertain quantities should ever be foreseen, or, in other words, that therapeutics should ever attain to the certainty even of a rational art, or, still more, of a science. Although it is not a science, yet it involves a large number of scientific elements; for, as will appear in the sequel, in many therapeutic problems there are chemical or physical conditions which can be accurately determined, and it is probable that with the progress of investigation the number of these will hereafter be greatly increased. Nevertheless, the modifying influences of the causes already noticed and of many others are so powerful and controlling, that in practice it is seldom possible to foresee the precise result even when the mode of action of the remedy is approximately known. As was before remarked, those remedies are most efficient whose action upon the economy is most obscure.

Before proceeding to consider more particularly the sources from which our knowledge of the curative power of medicines is derived, it is proper to premise what should be understood by the phrase to *cure* disease. The word to *cure*, in its proper and etymological sense, means "to take care of," and it is only derivatively that it has come to signify to heal or "to restore to a sound or healthy state." The distinction is happily expressed in the Latin line, *Medicus curat, Natura sanat morbos*, Physicians *cure*, but Nature heals. Medicine is only the handmaid of Nature, the really active and efficient agent in the restoration of health; Medicine can do no more than remove the impediments from Nature's path, support her when faint, restrain her when violent, and guide her when she is inclined to err. But the vital powers and functions of the organism have an inherent tendency to return to their normal condition.

when deranged by any cause, and to remove or repair the alterations of structure which may have attended that derangement. In this consists the healing power of Nature, *vis medicatrix Naturæ*, which, under various names, was recognized even in the earliest stages of Medicine, and, indeed, more fully then than at any subsequent period until modern times.

In diseases the least amenable to art, as well as in those acknowledged to be spontaneously curable, the power of nature is clearly manifested. It is not pretended that any human resources can secure the arrest of tubercle, yet nature not unfrequently converts the tuberculous into a calcareous deposit, in which form it remains permanently innocuous. The highest achievement of art is to sustain nature, that she may have time and energy, if possible, to perfect her work. The whole process by which wounds are healed is a natural one; and consists simply in the establishment of the nutritive process between the divided surfaces; of the exudation of a plasma and of cells, the formation of bloodvessels, and the absorption of the excess of material. And yet for thousands of years this simple method of nature was set aside by man's contrivance, and wounds were deluged with oil and wine and various unguents, which substituted suppurative inflammation for the adhesive process, and both aggravated and prolonged the patient's suffering. But if nature is so efficient in healing external lesions, we must presume that she exerts the same power in diseases of internal organs, for the elements involved are essentially the same in both. Even more than this, a little observation informs us what is the method she adopts to prevent the development or extension of morbid processes and to reduce their activity.

A great many diseases have their starting-point in the contact of an irritant with some portion of the organism; it may be a mote, a splinter, or something which excites a peculiar susceptibility in the part; and in all of these cases we observe that an effort is made to reject the offending substance from the body. A particle of sand lodges upon the membrane that covers the eye; immediately acute pain occurs, the closed eyelids refuse to expose the irritated organ to the light, a flood of tears pours over the ball to wash the offending body away, the colorless bloodvessels become distended, and tortuous, and red, secreting mucus abundantly, and, if the irritant still remains, also forming pus. All of these changes are evidently exaggerations of the normal functions of the organ, which is so constituted for the very purpose of remedying those evils to which it necessarily is exposed. Its structure and function involve its possession of a conservative power over its own integrity. Or, again, a substance is taken into the stomach which is insusceptible of assimilation, or which is capable of acting as an irritant of the gastro-intestinal mucous membrane. It tends to excite vomiting or purging, and is expelled from the body, or it merely augments the secretion of mucus which sheathes and protects the bowels. A splinter or other foreign body is lodged in the flesh; it usually excites suppuration around it, by which it is loosened from its con-

nections, and on the opening of the abscess is discharged. Or, as in the case of a leaden bullet, the tissues around it often become thickened and form a cyst which cuts off its communication with the rest of the body. Even in ordinary inflammation, the tendency to form an abscess, or at least to erect a barrier of coagulated albumen between the central seat of the lesion and the surrounding structures, illustrates the conservative operation of nature. For, if the powers of life have fallen so low that the required effusion of albumen fails to take place, diffuse inflammation of the cellular tissues ensues, and perhaps gangrene, terminating, if not in death, yet in irreparable injury to the organs involved.

Congestion, which is usually the first stage of inflammation, may occur as an isolated phenomenon, the result sometimes of local, and sometimes of general causes. It consists merely in an undue distension of the bloodvessels of a part, and may be terminated by their giving passage externally to the blood itself, to serum, a constituent of the blood, or to mucus or some other proper secretion formed from the blood. And plethora, which is a general fulness of the bloodvessels, often threatening apoplexy, or a dangerous tension of various important organs, is frequently relieved spontaneously by bleeding from the nose, anus, or other part.

The doctrine of crises, which formed so capital an element of the Hippocratic pathology, and the one of all others which does not countenance a perturbative treatment, was a clear recognition of the sufficiency of nature to cure disease, provided that her efforts are untrammelled. According to this doctrine, all acute febrile diseases tend to terminate on certain days by discharges of blood, or of mucus, urine, serum, sweat, etc.; or, in other words, whenever a cure occurs, it is effected by and through the proper powers of the constitution itself. In these diseases, also, we observe, on the one hand, an unwonted excitability of the nervous system which consists of mere restlessness, or which may rise to delirium and frenzy, and on the other, when a tendency to recovery is established, a disposition to repose and sleep, which thus provides a natural remedy for the over-tasked brain. Nor should we forget that among the first symptoms of acute disease are pain, debility, and loss of appetite, which are so many injunctions of nature to cease from toil, to seek repose, and to abstain from food.

But while we may learn from these illustrations the reality of the part which nature takes in the cure of disease, and the wisdom of following rather than of attempting to lead her, it is equally true that there are cases in which prudence and moderation are commanded by an opposite motive, by the impotence of nature and even of art to avert a fatal termination.

Physicians are daily blamed for their inability to save the lives of the sick, and many of them, it is to be feared, do not clearly apprehend, or apprehending, are unwilling to acknowledge, why such narrow boundaries limit the power of medical art. But the difficulty of forming just ideas upon this subject arises from overlooking, or not properly appreciating, the changes of structure produced by

disease. When a man's brain is crushed, neither physicians nor even the vulgar expect to see him restored to health, and medicine incurs no blame for his death. But if the cause of death be a rupture of the heart or an effusion of blood in the central portions of the brain, the fatal result is just as inevitable. Yet the physician only can appreciate this truth ; the layman does not perceive why these lesions should necessarily extinguish life, and he can scarcely repress the suspicion that some medical means ought to have been found to prevent the catastrophe which he laments. Other diseases accompanied with visible changes of structure, such as valvular and nutritive diseases of the heart, tumors which arrest the course of the blood or of the chyle through its main channels, and cancerous degeneration, the physician sees terminating fatally without anxiety or self-reproof, while the unlearned half hint that he or his art is responsible for the result. A step further, and doubts and difficulties assail the physician almost as much as the non-medical objector; nothing in the visible and tangible changes which the body has undergone can explain the fatal event, and when the propriety of the treatment and the skill of the physician are attacked, they cannot be vindicated to the complete satisfaction of the assailant nor always of the physician himself. His conscience will suggest the questions: Could nothing more nor different have been done? Would not a more experienced practitioner have been successful? And yet, in such cases, death may have been quite as inevitable as if the brain had been shattered, or the heart torn from its vascular connections. Blood of a certain composition is quite as essential to life as the integrity of any of the organs once expressively called *noble;* yet the nature, and still more the degree, of its alteration incompatible with life can only be guessed at. There is reason to believe that many of the most prevalent and fatal maladies which scourge our race, are essentially constituted by a vitiation of the blood in its origin, or by the retention within the vessels of substances which are excreted in health. With our present means of research, these obscure and complex problems cannot be fully solved, and consequently the curability of such diseases can only be shown by the results of their treatment. The large mortality in cholera, typhus and yellow fever, and other pestilential maladies, does not form a just reproach to medical art; for the absence in them of organic lesions capable of explaining death, proves that a profound and mortal change, not fully cognizable by the senses, must take place in the vital fluids of the body, and agrees with experience in demonstrating that a large number of cases of these affections are inevitably, and from the onset, fatal. Laymen cannot be expected to have accurate information upon such subjects, and should abstain from expressing opinions respecting them; but if physicians themselves were sufficiently alive to the views here presented, they would neither, on the one hand, suffer pain for a duty ineffectually performed, nor, on the other, prescribe so much at random, as in desperate cases they are apt to do, or neglect to apply the appropriate remedy at the precise point of time when it is needed.

Between the two extreme classes above referred to—of diseases in

which nature alone is competent to the cure, and those in which neither nature nor art avails to avert death—there is a middle class, in which the skill of the physician and the power of his art are chiefly manifested. They are affections, some of which have little or no spontaneous tendency to cure—as goitre, syphilis, chronic malarial diseases, etc.—or else incidental states or phases of continued fevers, inflammations, and other non-specific affections. In these medical skill alone outweighs the power of disease and inclines the balance from death to life. On some of such affections appropriate remedies exert an unexplained, and, as it is called, *specific* virtue; in others the disordered function or altered structure can be restored to a healthy condition by means of medicines which possess a definite and intelligible mode of action. The greater number, by far, of medicines belong to the latter category, and in their use justify the saying that Medicine is the handmaid of Nature, not supplanting her mistress nor usurping her rights, but actively assisting her to maintain them. In very many cases the patient is ready to perish from sheer feebleness, if unaided by art. When manual or surgical aid is required, this fact is almost too palpable to need illustration; when the malposition or relative size of the fœtus would prevent its being born alive, the hand or the instrument of the obstetrician preserves its life and saves the mother from inevitable death; when a foreign body rankles in a wound, a sequestrum perpetuates lameness, a calculus renders existence insupportable, or an abscess destroys all rest, or, by pressure upon a vital organ, may put an end to life, the surgeon's instrument has the life-giving power of Ithuriel's wand. So the physician, by a timely use of evacuant and sedative measures, prevents the fatal effects of congestion of the brain, the lungs, or other important organs, cuts short inflammatory disorders in their forming stage, relaxes the unyielding uterus, etc. Less sudden in action, but not less real in power, are the physician's elixirs, in the numerous diseases at some stage of which the vital powers flag and faint; they arouse and feed the flickering flame of life until the crisis is past, and the strength of the system suffices for itself. In cases of chronic and incurable disease, his skill often avails to prolong life, and to restore, even if not permanently, a useful degree of vigor. It often happens, too, that by an opportune treatment he arrests the formation of structural alterations which ultimately would prove fatal. So laryngitis is repressed before it produces asphyxia, meningitis before it occasions coma, endocarditis is palliated so that the heart does not become disorganized; the greatest dangers of typhoid fever, of dysentery, of some forms of dropsy, are immensely diminished by a timely and judicious use of medicines. By the same means, and in the same diseases, the natural process of cure is often expedited, for whatever limits the pathological process must shorten and simplify the steps which lead back again to health. Above all, it is in palliating suffering that the influence of medicine is most commonly recognized. It is evident that such must be the effect of whatever represses morbid action; but, independently of its influence on the substance (so to speak) of the

disease, medicine is of infinite service in lessening the violence of the symptoms; for oftentimes, by their intensity alone, the powers of life become enfeebled, and at last succumb. Such symptoms usually are presented by the nervous system either primarily, or secondarily in consequence of the condition of the blood; and then narcotics, nervines, and sedatives, with depletion in certain cases, are found efficient in subduing fever, assuaging pain, in allaying excitement and restlessness, and in bringing on the influence of "tired Nature's sweet restorer, balmy Sleep."

Sources of Knowledge Respecting the Action of Medicines.

In studying the relations of a medicine to the cure of disease, two questions evidently claim precedence of all others. The first is, does the medicine really produce or promote the cure? and the second is, in what manner does it operate? The former of these questions can be answered by the results of experience alone; the latter may be solved partly by an analysis of the same experience, so as to detect the different steps by which the curative result is obtained, and partly by means of experiments upon healthy persons and upon animals, which demonstrate the essential action of the medicine employed.

As the whole object of medicine is the cure of disease, it is evident that direct observation of the effects of remedies in the treatment of disease must afford the most trustworthy information respecting the manner in which they induce the result. Such is, indeed, the method which has always been instinctively followed by medical observers, who thus sought to learn under what circumstances a substance becomes a remedy. In this manner the greater number of drugs have been introduced into the Materia Medica. Nor is it at all probable that any advances which may be made in pathology on the one hand, and in a knowledge of the physiological action of medicines upon the other, will ever impair the fundamental truth that therapeutics must be learned at the bedside of the sick. But this is one of the most difficult branches of medical inquiry; for it is sometimes quite impossible to distinguish between the symptoms of a disease and the effects of a medicine. Among barbarous nations, among the ignorant classes of Christian countries, even among the educated and refined, and among physicians themselves, we may constantly witness a tendency to attribute all of the phenomena which follow the use of a medicine to its operation, and often to it exclusively, whereas the greater part of them belong to the natural or the perverted functions of the economy, and their degree alone is, in most instances, at all affected by the medicine that has been given. Even when the medicine sets up a new train of actions, these are, in general, nothing more than movements of the economy itself put into operation in such a manner as to produce a salutary result, so that the real and immediate curative influence is an effort of nature aroused by artificial means.

Clinical observation of the effects of medicines is in itself extremely difficult, and it is moreover liable to so many errors, that its results must be accepted with extreme reserve. The universal, not to say irresistible, tendency to mistake a sequence for a consequence, which is above alluded to, is the primal source of these errors, and is apt to bias even the most conscientious observer. How frequently does the practitioner imagine that his prescriptions have induced the phenomena which belong to the development of the successive stages of a paroxysm of intermittent fever, or occasioned the resolution of a deposit which the recuperative powers of nature would have accomplished quite as speedily! How often does the patient's faith in his physician stand in lieu of all drugs! Not less fruitful of error is the pride of opinion, which, like a distorted or discolored medium, causes facts to appear unlike themselves, and inspires an obstinate adherence to error. From this the transition is short and easy to a positive and wilful misrepresentation of truth, to creating facts to sustain a theory, or to alleging results of treatment different from the true ones, perhaps the reverse of them. With such defects in the evidence upon which our conclusions rest regarding the action and efficacy of medicines, it is no wonder that every year witnesses the introduction of new ones with extravagant encomiums, and the oblivion of others which had been heralded with equal eulogy. But a mere persistence of belief in the virtues of a medicine does not necessarily prove them to be real. The old Materia Medica comprised many substances which we know to have been either absolutely inert, or incapable of producing the effects ascribed to them, and they continued to be used in full confidence for hundreds of years on the authority of Hippocrates, or Galen, or more modern masters in the schools.[1] Nor was it until the cultivation of the fundamental branches of medical science that they began to be required to give proof of the virtues they were asserted to possess, and it is only within a very few years that any systematic and accurate method has been adopted to discover their essential powers. This inquiry, it is true, has not only permitted many of the ancient remedies to maintain their place with undiminished reputation, but has even strengthened it by revealing or adding to the grounds upon which it rests. It has also enriched the healing art with a great number of new remedies whose value has been tested and confirmed by observations carefully made in many

[1] The history of medicine is full of instances which demonstrate the earnest endeavors of mankind to obtain relief from suffering by a resort to means the most laborious and costly on the one hand, or the most painful and disgusting on the other. One of the most extraordinary of such perversions of intelligence is shown by the administration of animal excrement for the cure of disease. Dr. Erasmus Wilson refers to *stercum canis* (dog's dung), or *album græcum* as it was called in the old pharmacopœias, as a perhaps valuable form of phosphate of lime, and to the virtues of urine in allaying itching. (*Journal of Cutaneous Medicine*, ii. 310.) Early in the last century was published a work in which various combinations of human and animal excrements constituted an entire pharmacopœia for the cure of every disease under the sun. (K. F. Paullini's *Dreck-Apotheke*. Franckfurth am Mayn, 1714.)

countries and under varying circumstances during a long series of years.

In pursuing this investigation, it is not the effects of a medicine in one disease alone which we can expect to reveal its peculiar virtues or its mode of action. Its apparent action must be observed and compared in various diseases, at different periods also of the same disease, and, moreover, according to the doses in which it is administered. Whether or not this method will conduct to a knowledge of the manner in which medicines cure disease may very well be doubted; but, what is more important, it determines, with all possible accuracy, the circumstances under which a particular remedy must be given to insure its appropriate effect.

It has often been denied, and by eminent authorities, that the rigid mode of analysis known as the "numerical method" is at all applicable to therapeutical inquiries. But surely this is an error If experience has any value in therapeutics, it is because similar pathological conditions are constantly reproducing themselves, and are cured by the same methods of treatment. And if morbid conditions obey a law in their mode of development and decline, the medicines which more or less uniformly modify those processes must do so in virtue of an inherent law. If, therefore, the pathological conditions can be ascertained, it can also be determined under what circumstances they are influenced by medicines so as to terminate in health. To deny this would be also to deny that the effects of a medicine in disease can be anticipated at all, or that therapeutics is anything but guess-work. And, still further, it is not by the application of numerical analysis to the influence of particular medicines upon diseases regarded only as units that we exhaust its usefulness. For the greater number of diseases—nearly all, indeed—consist of a few definite changes in the blood or solids, producing symptoms which differ with the organ or tissue affected. Doubtless there are elementary conditions or lesions, however occurring, which are uniformly controlled by the same remedy; depletion everywhere modifies, at least, the forming stage of inflammation; mercury everywhere acts upon its products; opium in all cases assuages pain, etc. These uniform effects are determined by observation and the aggregation or addition of similar facts; and the more systematically they are ascertained, the more absolute will the results become. The latter class of general facts form the foundation or principles of General Therapeutics, the former the laws or precepts of Special Therapeutics.

Hoffmann, brilliant theorist as he was, has shown in his writings that he knew what limits to impose on theoretical speculations, and that, whatever their appropriate field may be, it certainly is not therapeutics. "The primary and most solid foundation of therapeutical truth and medical judgment is," he remarks, "a detailed history of both patient and disease, in all points full and complete." And in another place he says: "There is no way of escape from the labyrinth of doubt created by controversy about the powers of different medicines, except by carefully and diligently consulting the records

of cases in which medicines have been found useful or injurious."[1] Two other great men of the same epoch have left a similar judgment upon record. "The whole philosophy of medicine," says Sydenham, "consists in working out the histories of diseases, and applying the remedies which may dispel them; and experience is the sole guide."[2] Baglivi's admirable treatise abounds in similar expressions. "The peculiar aim of practice is," he remarks, "to adjust all the weighty concerns relating to the cure of diseases, pursuant to the laws of experience. He who pursues a contrary course, and forms his notions of practice from the rules of theory, will never be a successful practitioner."[3]

In spite of the warnings uttered by these and many other great men, the domain of therapeutics is, at the present day, continually trespassed upon by pathology, physiology, and chemistry. Not content with their legitimate province of revealing the changes produced by disease and by medicinal substances in the organism, they presume to dictate what remedies shall be applied, and in what doses and combinations. Their theories are brilliant, attractive, and specious, and they seem to satisfy a craving experienced by every reasoning man for an explanation of the phenomena which he witnesses; but, when submitted to the touchstone of experience, they prove to be only counterfeits. They will neither secure the safety of the patient nor afford satisfaction to the physician. Treatises which profess to furnish a method of treatment "deduced from the pathology" of a disease, are monuments of their author's self-deception, and snares to those who seek in them reliable grounds of practice. "In order to choose a drug," says a recent lecturer on the action of medicines, "which will have the effect that we desire to obtain, we must know where the morbid changes are taking place, and what their nature is; and we must be sure that our medicine will act on the affected part, and in such a way as to counteract the disease." It is amazing that teachers holding the reputable position which this one occupies, should venture upon such propositions, when every hour of their own experience contradicts them. We surely cure pain by opium, ague by quinine, syphilis by mercury, and epilepsy by bromide of potassium, without possessing the least antecedent knowledge of the seat or nature of the disease or of the operation of the remedy, in either of the cases mentioned. Such ideas of medical science as those above quoted inspire a prejudice against all science, among the many who cannot detect their sophistical errors, and regret among all who would see the science of medicine walk in her proper place led by the wisdom of a philosophical empiricism.

The antiphlogistic treatment of pneumonia has often been cited as an illustration of the "rational" method in therapeutics. We were told that the first principle in curing an inflamed organ is to give it rest; but as there is no rest for the lung, reason requires us

[1] Opera omnia, i. 286, 291.
[2] Works, Syd. Soc. ed., i. 2.
[3] The Practice of Physic, p. 132.

to diminish its labor by abstracting blood, and accordingly depletion was held to be the capital remedy for pneumonia, and experience has for centuries appeared to agree with reason in sanctioning this practice. But when once the natural cure of pneumonia had been studied, it became apparent that loss of blood is very seldom essential to the patient's recovery, and that it is more generally mischievous than useful in any but the forming stage of the attack. In this stage, however, its utility is demonstrable, and is, moreover, explicable upon the ground that the fibrinous effusion is then slight and absorbable. Yet this well-known pathological fact availed nothing to modify the treatment of pneumonia, until direct experience illustrated and explained it; because a perturbative and spoliative method, presumed to be rational, was also believed to be the most successful. It has been known from time immemorial that alkaline waters are useful in certain calculous complaints, and that iron is a specific for certain forms of chlorosis; the principle of their curative action is of modern discovery, if, indeed, it is discovered. We are directed to use alkaline mineral waters to cure the lithic acid diathesis, because the base and the acid neutralize each other. Yet the very same waters are capable of curing the phosphatic diathesis. Is it then quite certain that they become curative by virtue of their alkalinity at all? Iron, we are assured, is a specific remedy for chlorosis, because it supplies an organic element which in this affection is deficient, viz., the coloring matter of the blood. Admitting the correctness of this explanation or not, the fact is neither more nor less certain; its authority rests on the uniform testimony of physicians for thousands of years. There is not, we believe, a single example of a medicine having been received permanently into the Materia Medica upon the sole ground of its physical, chemical, or physiological properties. Nearly every one has become a popular remedy before being adopted or even tried by physicians;[1] by far the greater number were first employed in countries which were and are now in a state of scientific ignorance; and even metallic medicines, which owe their introduction, as internal remedies, to experimental philosophers, gave no indication, however faint, of their peculiar virtues, until they were experimentally disclosed. No process of argument that ever was invented can establish a reasonable presumption that a medicine will be of service, until its qualities have been tested by its actual administration to the sick. Its taste and smell and other operations upon the healthy system may furnish ground for conjecture that it will be beneficial in certain morbid states, simply because these qualities recall those of other substances known by experience to be useful in the conditions supposed. We cannot impress too strongly upon the mind the fundamental truth

[1] Hebra, speaking of the treatment of scabies, says that, in regard to it, "quacks and old women had more sense" than their learned competitors. "If medical men in those days had but observed with unprejudiced eyes the favorable results which followed the use of popular remedies and cures for scabies, they probably would have much sooner acquired correct notions concerning the nature and treatment of the disease." (*Diseases of the Skin*, ii. 231.)

that direct observation of the effects of medicines is the only possible foundation of therapeutics;[1] for, recognizing it clearly and following it reverently, we shall be content to concentrate all our powers upon nature, and listen to the responses which she makes to our earnest inquiries. We shall be content, by careful and prolonged, direct and comparative experiment and observation, to arrive at those practical conclusions which do not form the doctrines of a day or of a sect, but of all time and of the whole medical world.

If a direct analysis of clinical observation proves it to be the essential ground of therapeutical doctrines and precepts, an estimate of the value, in this relation, of experiments upon the healthy organism in man and the lower animals only strengthens the conclusion. The more extensively and accurately such experiments have been performed, the more evident does it become that the conclusions to be drawn from them can never serve as therapeutical rules, whatever light they may throw upon the manner in which particular medicines act upon the economy, and thereby furnish us with most valuable information respecting the limits of their power for good and evil.

The uniform action of a medicine upon healthy structure or function is its physiological operation; its curative action upon diseased structure or function is called its therapeutical operation. To determine the former seems comparatively easy, for, as compared with the abnormal, the normal action of the system may be viewed as constant and uniform. But in the latter case we are required to estimate the influence of an agent upon functional and structural conditions, with the natural termination and tendencies of which we are only imperfectly or not at all acquainted. Whatever else they may do, experiments upon the healthy organism can never fully reveal the manner in which medicines cure disease, because in the latter case elements are involved which do not exist in the former. But if we are ever to acquire a distinct idea of the curative operation of medicines, that is, of their operation upon the tissues, organs, and functions, when they have departed from their normal condition, we must possess a standard with which to compare the effects that medicines produce; and no other standard is available than the operation of the same medicines upon the healthy economy.

But let us not suppose that even this method is exempt from difficulties and imperfections. The perfectly healthy constitution which the problem demands is seldom to be found; or else individual peculiarities exist which, unless the experiments are frequently repeated, require us to accept their results with circumspection. Age, sex, and constitution modify the action of medicines, and accidental circumstances, such as climate, season, and occupation, are not without their influence. Doses of cathartic medicines which are habitually used in cold and temperate regions would be fatal in tropical climates. Idiosyncrasies, as they are

[1] Non post Rationem Medicina inventa fuit, sed post inventam Medicinam Ratio quæsita est.—Celsus.

called, peculiar and inexplicable susceptibilities, frequently modify, and even reverse, the ordinary action of a drug. Ipecacuanha in the smallest dose may occasion violent coryza, or bronchial spasm, or the least quantity of mercury excite ptyalism or produce nervous prostration. The various modes in which alcohol affects different persons are of common notoriety; it excites one to laughter, another to rage, depresses one in sombre dulness, and on another operates as an emetic; the famous question "cur opium facit dormire?" may be answered by a flat "nego;" for the drug in some cases seems incapable of exerting a narcotic influence. If, then, a medicine "produces a definite effect on one person when taken in particular quantities, while there is no certainty that a like result may follow its administration in the same doses to others; and if this uncertainty exists in regard to remedies whose action is eminently patent to our observation, and well marked, may it not prevail in regard to others whose operation is less marked, and whose effects are therefore not so perceptible, and thus serve to complicate the inferences which may be drawn respecting them?"[1] These cases are, it is true, exceptional, and while they should inspire us with a prudent scepticism in regard to the apparent effects of medicines when used in only a limited number of cases, they cannot seriously impair our confidence in the conclusions drawn from numerous and well-conducted experiments.

In disease the case is more complicated still. In many affections, as in fevers, there is probably not a single cell in the whole body which performs its function normally. In no two diseases, and frequently in no two stages of the same disease, are the aberrations precisely the same. It might, therefore, be anticipated that medicines would act differently in health and disease, and in the varying conditions of the latter. We can, with some confidence, foresee the effects of medicines in health, but in disease there is no experienced physician who does not feel uncertainty, and indulge in some self-gratulation when the result corresponds to his predictions. Let no one interpret this statement as an admission of the nullity of medical treatment. It would be as logical to regard life and health as worthless because nothing is more uncertain than the former, and because the very air we breathe, the food we eat, the clothing we wear, every action, every emotion, almost every thought, may be to us an instrument of death. The whole of life is a perpetual struggle with an enemy to whom we must at last succumb, and the wonder really is how often human skill, founded upon science and experience, has succeeded in postponing the inevitable catastrophe.

The difference between the operation of medicines in health and disease has been noticed ever since their actions were experimentally investigated. "The same remedy has a different effect," says Boerhaave, "on the sound man and the sick one. A prudent physician will not forget this, but remember that Galen has said, 'The prescription of a medicine is indeed under your control, but its effects

[1] W. Procter, St. Andrew's Med. Grad. Assoc., Trans. 1869, p. 118.

are not.' "[1] The different modes of action of a plaster of cantharides upon the skin will illustrate this statement. The integument in its normal state will, under this operation, gradually become red, and then be vesicated; after which the serum will be discharged, and the part will heal. But in the cold stage of a periodical fever, or in the collapse of cholera, the same plaster will produce no impression at all. If applied to an erysipelatous part, on the other hand, it may excite violent pain, and produce intense redness, excessive swelling, and perhaps even gangrene. When, again, the cutaneous inflammation is local, superficial, and chronic, the very same application may be salutary and effect a complete cure. Iron, which seems to exercise an almost creative power in renewing the exhausted and paralyzed functions of anemic persons, will, on the contrary, when it is used by those in health, impair the appetite, confine the bowels, and occasion headache and hebetude. Alcoholic stimuli can be taken by typhus patients, and by those affected with tetanus, in doses which would fatally intoxicate healthy persons. And the same is true in regard to opium in the latter disease. Stranger still, the wine or brandy which naturally excites the pulse and brain, heats the skin, flushes the face, and renders the eye wild, will, in the epidemic forms of petechial typhus, allay excitement, calm delirium, cool the skin, and change its dusky hue to a more healthy tint. Opium, which, in general, produces constipation of the bowels, is the most efficient means of relieving the obstinate constipation of lead colic. Tartar emetic is one of the most powerful medicines of the emetic class, yet when coma is present, or the nervous energy is otherwise oppressed or exhausted, large doses of this preparation may be used without effect; and, on the other hand, in the minutest quantities it will excite violent vomiting when the stomach is inflamed.

It is possible to explain not a few of these anomalies and apparent contradictions by the state of torpor which frequently affects some or all of the functions, and especially those of sensibility and absorption. The nervous system, in many diseases, responds feebly to stimuli, either because it is primarily impaired, or because the blood upon which its susceptibility depends no longer affords it the requisite vitality. In other cases, the hurry and irregular violence of its action arise from a similar cause. In both instances it is easy to conceive that a diffusible stimulus will restore the balance of the system by a direct action upon the nervous centres. Other apparent anomalies arise from the non-absorption of medicines. In cholera, yellow fever, etc., mercurials may be administered in enormous quantities without producing salivation or any other constitutional effect. In the first-named disease the calomel which had been given has repeatedly been found unchanged in the stomach and intestines. Other cases, again, are explicable by a reference to what is known of the mode of the medicine's action. Iron is salutary in anemic chlorosis because it supplies an ingredient of the

[1] Quoted by ŒSTERLEN from Comment., i. 9.

blood which in that affection is deficient, and it is mischievous in health because it creates in the blood an excess of the same element. A blister will not vesicate the clammy skin of a cholera patient because the integument cannot absorb its active principle; it will occasion gangrene in an acutely inflamed part by making the physical changes in inflammation excessive and permanent; it will restore one in a state of chronic inflammation by rendering the organic processes more active, and so promoting a natural cure.

In nearly all of these, and similar cases in which it is possible to give a reason for the diversities of medicinal action, there is a substantial alteration of structure, of nutrition, or of the blood. But in many functional affections, *morbi sine materiâ*, the case is very different. In the whole range of remedies there is hardly one whose operation can with confidence be counted upon in certain functional diseases of the nervous system. Often it defies conjecture and sets at nought all rational anticipations.

A large amount of information, respecting the operation of medicines is to be derived from the study of cases in which they have been taken in excessive doses by mistake or with criminal intent. These display their operation in magnified proportions, as it were, and frequently reveal the alterations of structure which they tend to produce. They also serve better than the therapeutical action of medicines for comparison with the effects of the latter in experiments upon animals.

Such experiments are of great value, because they enable us to make a large number of comparative observations, varying the conditions at pleasure, so as to arrive, by exclusion, at those effects which are peculiar and essential to each medicine. We can also observe the different modes of their action according as they are administered by the stomach or bowels, applied endermically, or hypodermically, or to the surface of wounds, injected into serous cavities, into the bloodvessels, etc. By experiments in which sections of nerves or mutilations of nervous centres are performed, the degree and the nature of the influence of the nervous system in originating action or in modifying it are illustrated. Further, we can in this manner learn the diversity of effects produced by various doses, degrees of dilution or division, and modes of combination of the several medicines. But more distinctly than in any other way we can thus discover the lesions which are produced in the body by medicines capable of acting as poisons, according to their dose, form, etc. Indeed, without such experiments nearly all of our ideas concerning the operation of medicines would be purely conjectural. It is true that they are not to be placed on an equal footing with similar observations made upon man, when these chance to present themselves; for while man can describe his sensations, we can only conjecture those of an animal by its agitation and functional disturbance. It is also to be remembered that many medicines do not affect man and the lower animals alike. They may be poisons to the former, and food to the latter. Hemlock, and water hemlock (*conium maculatum*, and *cicuta virosa*) are eaten

in considerable quantities by cows without injury, but they are poisonous to man. Albers relates that he gave ten grains of pure morphia to a rabbit without producing any of the effects of opium. To another he gave twenty-five grains of this substance without destroying it. Eight days afterwards he administered to the same animal a drachm of opium and ten grains of morphia. It lived, and gave no sign whatever of narcotic poisoning. Dr. S. Weir Mitchell found that pigeons are almost unaffected by opium internally administered; and Dr. B. W. Richardson, who used subcutaneous injections, obtained the same results. Goats offer a resistance to nicotine. The difficulty of affecting rabbits by belladonna and atropia is elsewhere illustrated. Horses can take large doses of arsenic without injury, so large, indeed, says Albers, that they would destroy as many men as would weigh twice as much as a horse.[1] Infusion of quassia, which to man is a salutary tonic medicine, is extremely poisonous to flies, and destroys even dogs when injected into the veins. In herbivorous animals, as the rabbit, vomiting never occurs, while in carnivorous animals, as the dog, it is readily excited. Moiroud states that colocynth, jalap, gamboge, and bryony, which operate as violent purgatives on man and carnivorous animals, have comparatively little effect on the horse and other herbivorous animals. Even among these last there are differences which it is important to be acquainted with. Colin states that it is difficult to compare, for example, the action of certain medicines in the stomach of the horse and in that of the ox. The organ in the former is small and retains the alimentary mass for a short time comparatively, so that medicinal substances are speedily carried to the intestine and absorbed. In ruminants, on the other hand, the stomach is very capacious, and much of the food may remain in it for several days, so that medicines mixed with the bulky mass are very slowly and gradually absorbed, and consequently occasion comparatively slight effects.[2] These curious facts are sufficient to enforce circumspection in examining the results of experiments upon animals, and to show that when we would make inferences from the latter to be applied to man, we must be sure that the cases are comparable with one another. Of their value when properly conducted there can, however, be no doubt, or, if any one is still sceptical upon this point, let him reflect that the primary doctrine, or rather the fundamental fact, of the absorption of medicines would probably not have been demonstrated without them.

In estimating the value of experiments upon healthy men and upon the lower animals as a means of giving scientific accuracy to therapeutics, we should be careful not to confound two subjects which are essentially distinct, the action of a medicine upon the organism itself, and its action upon morbid elements within the organism. Some diseases consist essentially of perverted actions or

[1] Handbuch der allgemeinen Arzneim., Bonn, 1854, p. 1.
[2] Bull. et Mém. de la Soc. de Thérap., i. xv.

conditions of the natural organism without the presence of any foreign element whatever; but other diseases depend primarily and essentially upon the presence and operation of a foreign element which is sometimes described as a morbid poison. The latter class includes the eruptive and periodical fevers, whooping-cough, influenza, cholera, glanders, hydrophobia, syphilis, and perhaps some others. Into the greater number of these affections anatomical and physiological researches have been made without any approach to a demonstration of the remedies fitted to cure them, or even of the qualities which such remedies should possess. On the other hand, we know little or nothing concerning the mode of action of such remedies as have been proved by experience to possess the power of curing certain of these diseases, of cinchona in periodical diseases, of mercury in syphilis, of iodine in goitre and scrofula, for example. We witness the usual, if not the uniform, curative operation of the medicines, but we are less acquainted with the means by which they effect a cure than we are with the action of medicines in general which are destitute of any specific power, and only tend to mitigate, or to eliminate it may be, certain symptoms, which are common to many diseases.

In conclusion, while we desire to impress upon the reader that the scientific physician should first of all acquaint himself with the action of medicines upon the healthy organs, and next, should learn their comparative operation upon the same organs in disease, yet it cannot be too often repeated that simple experience forms the only crucible in which a therapeutical fact or doctrine can be fairly tried. Whatever sustains this test may be accepted as a real and permanent addition to our therapeutical resources. But the results of experiments upon the healthy organism cannot possibly attain to such importance; they can only illustrate the manner in which medicines cure disease, as physiology illustrates the phenomena which constitute disease.

The Physiological Action of Medicines.

The operation of medicines may be studied under two heads: 1. The means by which they act upon diseased parts; and, 2. The modifications induced by them in those parts, and which tend to restore the latter to health. The former constitutes the mechanism by which the medicine is enabled to operate, and includes its local action, the sympathetic phenomena it induces, and the phenomena accompanying its absorption and diffusion. The latter comprehends the vital, physical, and chemical effects produced by medicines, the manner in which they convert morbid into healthy action, and the influences which tend to restrain, augment, or pervert their operation. The one is a physiological, the other a pathological and therapeutical inquiry; but unless the phenomena and the laws revealed by the first are clearly apprehended, it is impossible to prosecute the second or to set a proper value upon its results.

THE LOCAL ACTION OF MEDICINES.

The local changes produced by medicinal substances are those with which we are best acquainted, because in many cases they are open to our senses, and thus we are enabled to infer with strong probability that similar effects are produced by the same agents upon parts concealed from our direct inspection. We are at once struck by the fact that the reaction of a part is proportioned to its degree of vitality. If it be absolutely dead, no effect will be produced upon it by any other agents than those which act through their chemical affinity with its constituents. On the other hand, if its vitality be of a high grade, there will be a prompt, active, or even violent reaction. Between these two extremes every degree of susceptibility may be observed. To cite anew the illustrations which have already been adduced: in the cold stage of algid intermittent fever, or in the collapse of cholera, the most active irritants applied to the skin fail to awaken any sensation or produce any redness, but their appropriate action will be manifested as the integument regains its vitality. In those states of the brain which induce insensibility, the action of many medicines is impaired or suspended. So emetics and purgatives fail to operate during narcotism, deep intoxication, and congestion of the brain.

The physical qualities of the substance itself also influence its local action. It may, like watery, mucilaginous and most oily substances, have a purely negative influence, which, however, may become extremely valuable remedially; or it may be quite inert by reason of its insolubility, as is the case with many powders applied to the skin. Such applications are intended to limit the exhalation of a part and to protect it from irritation. But the nature of the part modifies still more sensibly the operation of medicines applied to it. In this respect the skin is much less susceptible than mucous membrane. It is not only covered by the cuticle, which is no longer vital and is insensible, but its proper tissue is comparatively dense and unyielding, and less adapted than the mucous membrane to be penetrated by medicinal substances. It is, however, susceptible of inflammation by irritants, and to a peculiar effect of irritation, vesication, which consists in the secretion of serum by the chorion beneath the epidermis. It is often, also, attacked by caustics which enter into chemical combination with its constituents, destroying their vitality and organization. On the other hand, direct means are frequently employed to lessen the vital activity of the integument; such are cold, the great local antiphlogistic, and astringents, which also operate by repelling the blood from an inflamed part, and preventing the pain of its pressure and the morbid changes of nutrition it would otherwise occasion. Still other agents used as external medicines are cosmetics, resorted to for removing discolorations and slight eruptions from the skin, and depilatories, which usually consist of caustics capable of destroying the hair.

Medicinal substances are applied to mucous membranes either for the purpose of modifying their morbid condition, or for a

remoter operation. In the former case the same protective and irritant agents may be used as in the case of the skin, but as certain mucous membranes, those of the stomach and small intestines, for example, secrete liquids which may have a chemical reaction with the applied irritants, the operation of the latter may be greatly modified or completely annulled. Thus, when nitrate of silver is taken into the stomach, it is speedily neutralized by the secretions of this organ, and converted into chloride of silver, an innocuous compound. The greater number of medicines applied to the mucous membrane are intended to augment or to diminish its secretion. Of the former, purgatives and emetics may be taken as examples, and of the latter, astringents.

In studying the local application of medicines, we must not overlook their power of *penetration*. This is not identical with their absorption, a function which will presently be examined, but it is the power which medicines have of producing their effects, often energetically, upon neighboring but not functionally related parts. It is a universal custom to apply local remedies in the neighborhood of the affected organ, although no direct connection between the two points exists. That the operation is thereby rendered more powerful, admits of no dispute. A blister of cantharides, applied to the hypogastrium or the loins, will be much more apt to produce strangury than if it vesicated the breast or the neck. Strychnia has been shown, by Albers, to occasion tetanic spasms much more readily when it is applied along the spinal column than when it is taken by the mouth, and when introduced into a wound in the former situation than into a similar wound upon the leg. Extract of belladonna applied to the eye, or in its neighborhood, will produce dilatation of the pupil more certainly than if it were taken internally, and the same remark is true of the application of this medicine to produce relaxation of the neck of the uterus, or of the sphincter ani muscle. If we wish to discuss an indurated gland by means of iodine or mercury, we apply them as directly as possible to the part affected, knowing that their internal administration would be much less effectual. It is customary to apply cups, leeches, blisters, cataplasms, etc., to the surface of the chest or abdomen when the lungs, heart, or bowels are inflamed, and their utility is unquestionable, although no direct connection exists between the seat of the disease and that of the medicinal application. In the last illustrations it is highly probable that the reflex function of the spinal cord constitutes the channel through which a portion, at least, of the curative influence is transmitted.

THE REMOTE ACTION OF MEDICINES.

The remote, secondary, or constitutional operation of a medicine is that which it produces elsewhere than on the part to which it is primarily applied, or on those which are in direct physiological relation with it. Thus, strychnia and cantharides are primarily

local irritants, but remotely or secondarily the former acts upon the spinal marrow and the latter on the urinary organs. In the greater number of cases a medicine gives rise to such numerous phenomena that it becomes a difficult question to decide how far they depend directly upon its administration, or are remotely occasioned by it. It is of necessity still more difficult to determine in what manner the effect is produced. The remote operation of medicines can only be effected through one or the other of two channels, the nerves or the bloodvessels, since these are the only known media of communication between distant organs of the body. There are those who maintain that the one or the other of these is exclusively the channel through which the medicinal influence is transmitted; but as in their physiological and pathological relations we know that both maintain a reciprocal influence between the several parts of the body, it may be presumed that both partake also in diffusing the curative operation of medicines. Direct observation confirms this view of the subject, although it shows at the same time that the two agencies are not of equal importance, and that the greater number of therapeutical actions are due to the introduction into the blood of medicinal substances, which are thereby conveyed to every part of the body.

But many nervous phenomena are produced by medicines which, for that purpose, at least, are not required to enter the circulation. Many local irritants, including electricity, produce a disturbance of the nervous force, manifesting itself by a spasmodic action of the muscles. The phenomena of emesis and catharsis, including nausea, colic, retching, tenesmus, vomiting, and purging often depend upon a purely local reaction between the medicine and the gastro-intestinal tube.

The spasmodic closure of the larynx against the entrance of chlorine, ammonia, and carbonic acid; the spasm of the respiratory muscles produced in some persons by the emanations of ipecacuanha; the vomiting excited by the passage of a biliary or vesical calculus; the nervous exhaustion occasioned by intense pain, and by the "shock" of severe accidents in which a limb is crushed, or a large portion of the body burned or scalded; the fainting and even death which sometimes result from sudden and agonizing mental emotion; these are some out of the many illustrations that might be adduced to show how powerful are the actions which may be aroused through the nervous system alone.

Other impressions are occasioned by the local action of medicines upon the nervous trunks or extremities, without the intervention of the circulation, as in the *penetration* noticed above. Anodyne and anæsthetic applications, such as opium, belladonna, veratria, and aconite, may relieve local pain without affecting the general sensibility. A frog's foot, kept moist with laudanum or prussic acid, loses its power of motion without the general sensibility having been impaired. Lembert states that in a case of paralysis from lead affecting the upper limbs, he applied a blister to both arms, and dressed one of the sores with strychnia. The paralysis on this side

improved, but on the other it was unaffected until a similar treatment had been made use of. In all these cases, the limited operation of the medicine seems to be unquestionable.[1]

In 1822, Dr. Hubbard performed a variety of experiments with prussic acid and nux vomica, in which, it is stated, these agents were applied with much less effect to bloodvessels than to nerves, and that their action was proportioned to the importance and extent of the nerves involved.[2] Dr. Pennock drew an identical conclusion from his own carefully conducted experiments;[3] and Dupuy and Brachet, without going so far, at least concluded that the division of the par vagum on both sides greatly diminished, if it did not neutralize, the poisonous effects of nux vomica and of narcotics introduced into the stomach. But these results are in direct contradiction with those of the greater number of observers. Fontana applied the venom of vipers, *ticunas* poison, water and oil of cherry-laurel, and opium, to the exposed sciatic nerves of rabbits and frogs, without producing any characteristic symptoms. He also tore and cut the same nerves without any notable effect. Wedemeyer obtained the same negative results by the application of prussic acid to the median nerve of a cat, in the space of two inches, and also to the infra-orbitar nerve and the par vagum of a horse.[4] On the other hand, when poisons are introduced into a limb whose nervous connections with the trunk have been entirely severed, the same effects ensue as if the nerves remained entire. This is proved by the experiments of Magendie and Delille, who destroyed animals by means of *upas tieuté*, introduced into a limb whose only connection with the body was through an artery and a vein; and, lest it might be objected that the parietes of these vessels transmitted a nervous impression, or otherwise conveyed the poison, the experiment was repeated with the substitution of quills for the bloodvessels. Thus we have positive and negative proofs combined, that the nerves do not convey to their central organs any specific impression of the poison employed. But even did the specific effects of the poisons used in cases of ligature of the nerves develop themselves in some degree, it must be recollected that nervous trunks are absorbing tissues. A similar criticism is applicable to those cases in which the passage of poisoned blood through a vein is prevented by a ligature. If the constriction of the vessel is sufficient to cut off its circulation entirely, and even through its nutritious vessels, its nervous filaments must also be incapable of conveying impressions.[5]

[1] Schultz, Allgemein. Pharmakologie, p. 96.
[2] Phila. Journ. of Med. and Phys. Sci., iv. 242.
[3] Am. Journ. of Med. Sci., ii. 9.
[4] Albers, Allgem. Arzneim., p. 228.
[5] Dr. B. W. Richardson maintains that the idea is a fallacious one that the nervous system can be reached only through the blood. He asserts that the heart of an animal recently dead can be influenced by nitrite of amyl applied to the olfactory tract or to the surface of the retina; and he accepts Dr. James Jones's conclusion that hydrocyanic acid can be made to act fatally by its direct application to the medulla oblongata. If the experiments of these observers do not bear a different interpretation from the apparent one, they are certainly in opposition with those referred to in the text, and to the generally accepted belief.

If the remote action of medicinal substances depended only on the local impression of the latter, the two would always be proportioned to each other; but, as Spillan has remarked, in the case of arsenic and other irritant poisons, when they destroy life by at once powerfully depressing the nervous system, the gastric symptoms and lesions are comparatively slight; while the suffering is most severe and the disorganization of the stomach is greatest when the nervous symptoms are less prominent. In this illustration, and in all cases in which a powerfully irritant agent is used, it is important to distinguish between the phenomena which it occasions as an irritant and those which depend upon its specific properties. Thus, arsenic and cantharides equally produce symptoms of violent inflammation of the organs of deglutition and of the stomach, but the Spanish fly occasions severe genito-urinary symptoms, which are absent in the other case.

It has been alleged in favor of the doctrine of sympathy that the phenomena produced by certain poisons occur with a rapidity that can only be explained by the transmission of nervous influence. But this argument rests upon a double misconception, first, of the time which actually elapses in the experiments referred to, and second, of that required for a substance to reach the nervous centres through the circulation. There must evidently be a probability of error in estimating the duration of a very short period, during which the mind is intently occupied and highly excited by the phenomena expected, or actually occurring. When precautions have been taken to avoid this error, the interval has been found to be longer than was suspected. Thus, Dr. Blake states, that after half a drachm of concentrated prussic acid had been poured upon the tongue, eleven seconds elapsed before any morbid symptom appeared; and that it required fifteen seconds to develop symptoms of poisoning by injecting ten drops of conia saturated with hydrochloric acid into the femoral vein of a dog. By the same experiment it was proved that the time required for diffusing a soluble substance through the body may not exceed nine seconds. Dr. E. C. Willis found that if prussic acid was injected into the pleura of a rabbit, and a ligature previously thrown around one of its legs was tightened the instant that the symptoms of poisoning commenced, the blood of this limb would furnish chemical evidence of the presence of the poison in from four to ten seconds after its introduction into the body.[1] Now it can hardly be supposed that a less period would be required for the poison by penetration to reach any nervous trunk or expansion capable of transmitting its influence to the nervous centres. Hering, of Stuttgardt, has also shown by experiments with ferrocyanide of potassium, that this substance may complete the whole circuit of the blood within twenty or thirty seconds. In this connection the experiment heretofore referred to must be noticed, viz., that a frog's foot soaked in prussic acid became insensible, but the system remained unaffected.

[1] Lancet, May, 1858, p. 541.

Some writers who maintain the exclusive operation of sympathy in the mutual relations of remote parts cite with satisfaction the experiment of Morgan and Addison, in which a carotid artery of one dog having been made to interchange its current with the corresponding artery of another dog, one of the animals was poisoned by inoculating it with a concentrated solution of strychnia. It died in seven minutes with characteristic tetanic symptoms, while the other dog manifested none of the effects of the poison. But it it is to be observed that a very small portion, comparatively, of the blood of the poisoned animal could have found its way into the sound one, because the circulation in the former began immediately to languish under the influence of the poison, to such a degree, indeed, that, as Blake remarked, the current of blood was probably from the sound to the poisoned animal; and, moreover, that it was arterial and not venous blood which was transfused, and therefore not as highly charged as the latter with the poison. Besides these reasons, a more convincing one is the positive experiment of Vernière, who found that the venous blood of an animal poisoned with nux vomica, when injected into the veins of another animal occasioned the same phenomena as occurred in the first instance. He also states that leeches are killed by the blood of an animal poisoned with the same substance.[1] In a case of poisoning by oxalic acid, Dr. Arrowsmith saw a number of leeches applied to the epigastrium die after they had drawn but a short time.[2]

It is also alleged against the doctrine of absorption that the fœtus in utero is not affected by a poison which destroys the mother. It is difficult to obtain reliable facts upon which to form an opinion respecting this subject, because the degree to which the child is influenced, when both it and the mother survive poisoning, cannot be determined. But it is very certain that some slow poisons do affect the unborn child. This is evidently the case with ergot during the epidemics produced by its admixture with flour made into bread; and a fœtus may be born with smallpox, although the protected mother may have escaped the contagion. Many cases of the sort are related, among them one by Jenner, and another by Aulsebrook.[3]

On reviewing the illustrations that have now been adduced, it will, we think, appear probable that those medicinal agents alone act exclusively or chiefly through the nervous system which directly excite one of its functions, whether it be intellection, emotion, the special senses, general sensibility, or motility. The number is indeed comparatively small of those which operate in this manner. Of internal medicines there are very few, if we except a limited number of purgatives, which do not operate by the means which we propose in the next place to describe.

[1] Journ. des Progrès, iii. 121.
[2] Christison on Poisons (Am. ed), p. 176; Med.-Chir. Trans., i. 269.
[3] Br. and For. Med.-Chir. Rev., xvi. 265.

ABSORPTION.

After the discovery of the lacteals, and the experiments of Sanctorius on cutaneous exhalation, the idea of the absorption of medicines and their dissemination through the body, began to be entertained. As late as 1763, Dr. Wilkinson thought it necessary to adduce a number of instances, of a striking kind for the most part, to prove the reality of the absorption of medicinal substances by the skin.[1] The experimental investigation and demonstration of the subject dates from the period mentioned, and in the first year of the present century a thesis was published in this city containing a full enumeration of the proofs then existing of the important doctrine of the absorption of medicines.[2] However interesting it would be to trace the gradual development of this now fundamental doctrine in therapeutics, we forego that pleasure, and proceed at once to illustrate it.

The proof that medicines are absorbed from the various surfaces consists mainly in their being found associated with the different constituents of the body.

The poisonous properties imparted to the *blood* by several substances have been already noticed. The admixture of foreign substances is also detected by the smell and color of the blood, and by means of chemical tests. The discovery of foreign substances in the blood demands peculiar skill, and this is no doubt a reason why their presence has been denied by some experimenters. But these negative statements could at no time outweigh the positive evidence which had been adduced, and the latter is now so abundant as to place the subject beyond the pale of controversy. A list of nearly forty substances, including the metals and metalloids, various salts, coloring matters, acids, essential oils, and odorous principles, thus detected, is given by Pereira, and it would be easy to enlarge it. When we consider how large a portion of these substances must be excreted, and how many remain in combination with the solid portion of the organs, and the new combinations which they form with the organic matters of the blood, or with other substances accidentally present in it, the wonder is that their presence should ever have been discovered at all. Mineral and saline substances are detected by chemical processes, but vegetable matters by their odor and by the color which certain of them, as indigo and rhubarb, impart to the serum; still, as a general rule, the coloring principle is either not absorbed, or not in sufficient quantity perceptibly to tinge the serum of the blood, although it may be found in the sweat and urine, and even in the bones. The odor of camphor, musk, alcohol, Dippel's oil, garlic, turpentine, assafœtida, oil of mustard, and oil of savin, has been detected by different experimenters. Many of these substances have been re-

[1] Medical Museum, Lond., 1763, p. 117.

[2] An attempt to prove that Certain Substances are conveyed unchanged into the Circulation, by EDWARD DARRELL SMITH, of Charleston, S. C.; CALDWELL'S Theses, p. 229.

covered from the blood unchanged, but it does not follow that the whole quantity absorbed was likewise unaltered. (Mitscherlich.)

The absorption of foreign substances, and their presence in the *chyle*, have been demonstrated in the case of various soluble coloring matters, owing to the natural absence of color in this liquid. It was early stated by Musgrave and by Fordyce, that indigo and sulphate of copper are thus absorbed, and the same result was obtained by Milnor; but Tiedemann and Gmelin, as well as Lawrence and Coates, were unable to detect the presence of any vegetable coloring matter in these vessels. But Macnevin showed that they absorbed hydrocyanate of potassa, and Coates, Lawrence, and Harlan, the ferrocyanate of potassa. In the first case the chyle gave a deep blue color with permuriate of iron, and in the latter with the sulphate of iron.[1]

Medicinal substances are found impregnating the *solids* also. The flesh of animals used for food acquires a degree of bitterness if their fodder contain bitter herbs, or it may become poisonous if they have eaten certain noxious substances. Thus, pheasants, which feed upon laurel berries, are believed to be poisonous, and the same is true of animals that have been poisoned with strychnia, arsenic, or belladonna. Humboldt and Bonpland relate that children who ate the food of gustavia spinosa, became all over of a yellow color. Some persons who have long taken nitrate of silver for epilepsy, have a bluish or slaty hue of the skin. Of this we have seen several instances; and numerous others have been reported by Swediaur, who first noticed the fact, and by Roget, Bertini, Badely, Vetch, Rayer, Lelut, and Wedemeyer.[2] In the Breslau Museum, the spinal column of a man who had formerly taken large quantities of mercury is to be seen, containing metallic quicksilver. A similar specimen is said to be in the Strasburg Museum. Albers found metallic mercury in the abdominal cavity, and in the inter-muscular cellular tissue, after inunction of the abdomen with mercurial ointment. Lead has been detected in the brain, the spinal marrow, the lungs, the liver, and the muscles of parts paralyzed by this metal. Copper, tin, antimony, zinc, and other metals, have been obtained from the liver. In many cases it appears that the metals have affinities for particular organs; as, mercury for the medullary portion of bones, copper for the muscles, and lead for the muscles and the brain. It is also stated that the metallic compounds with oxygen become partially deoxydized when they are deposited.

As the *urine* is the vehicle by which a large portion of the effete matter of the body is carried away, it might also be expected to contain a portion, at least, of the substances which are not assimilated by the economy. It was early known that the urine is colored, or has its taste or smell altered by various articles of food, and by several medicines, and also that these effects are sometimes produced even by the contact of certain substances, such as turpen-

[1] Phila. Journ. of Med. and Phys. Sci., iii. 273.
[2] Beck, Am. Journ. of Med. Sci., Jan. 1844, p. 39.

tine and garlic, with the skin. The effect of alkalies in calculous diseases was attributed to their absorption, and iron was detected, by means of nutgall, in the urine of persons taking the former medicine.[1] The subject has now been sufficiently investigated to render unquestionable the general fact above stated, and also to determine many laws which affect the elimination of the constituents of the urine.

The earliest series of experiments to elucidate medicinal absorption were those of Wöhler, in which dogs were used, and their results have, in the main, been confirmed.[2] Corresponding experiments were performed by Tiedemann in the case of a young man affected with exstrophy of the bladder, so that the urine could be collected and analyzed at the moment of its issuing from the ureters.[3] A case of similar malformation enabled Mr. Erichsen to make experiments of the same kind, and with closely analogous results.[4] The period required for the appearance of different substances in the urine varied from one to forty-five minutes. It now appears that many are excreted with the urine unchanged, including the chlorate, carbonate, and nitrate of potassa, and the iodide and ferrocyanide of potassium, vegetable coloring principles generally, and oil of almonds. Many odorous principles, such as those of turpentine, asparagus, valerian, castor, and assafœtida, become modified by secretion with the urine. The vegetable acids appear in combination with an alkali, and most of their salts as carbonates. The condition of the excreted mineral acids has not been fully determined, nor that of the metals, the presence of all of which in the urine has, however, been ascertained. Iodine appears as hydriodic acid or an iodide, and sulphur as sulphuric acid and sulphuretted hydrogen. Quinia, morphia, and the narcotic principles of belladonna, stramonium, aconite, and conium, are also excreted. Runge states that the urine of a dog poisoned by stramonium occasions dilatation of the pupil when applied to the eye of a cat, and this statement is confirmed by Casaseca.[5] Allan found daturia in the renal secretion, and Dr. Letheby states that the urine of animals poisoned by opium, belladonna, hemlock, aconite, etc., contains the active principles of these substances.[6] Agaricus Muscarius is a fungus employed by the Kamtschatdales, Samoyedes, and other tribes of Northern Asia to produce intoxication, and it is said that the urine of those who have used it becomes intoxicating in its turn, and that this influence may be transmitted to four or five persons in succession.[7]

In the *perspiration* have been detected the odorous principles of musk, garlic, assafœtida, and camphor, and the coloring matter of indigo, rhubarb, and saffron. Sulphur causes the body to exhale an

[1] E. D. Smith, loc. cit. [2] Journ. des Progrès, i. 41, ii. 99. (1826.)
[3] New York Med. and Phys. Journ., vi. 129.
[4] Am. Journ. of Med. Sci., Oct. 1845, p. 427.
[5] Orfila, Toxicologie, 5ème éd., ii. 307.
[6] Lond. Med. Gaz., Jan. 1847. p. 153.
[7] Murray, Apparat. Medic., v. 557; Merat and Delens, Dict. de Mat. Méd., i. 219.

odor of sulphuretted hydrogen, and to blacken articles of silver and gold worn near the person. Sulphur baths blacken the skin of persons who have been taking mercury or lead for a considerable time, forming sulphurets of these metals.

There is a difficulty in determining the exhalation of substances with the *breath*, because, if swallowed, they are apt to impregnate the mucous membrane of the mouth and pharynx, or their vapor escapes by eructation. But when animals that do not vomit are used for experiment, and the medicinal substance is introduced by means of a tube into the stomach, the sources of error are diminished. By such experiments upon rabbits, Mitscherlich found that the odor of alcohol, ether, fusel oil, fennel, and caraway oils, of oil of turpentine, juniper, mustard, and savin, could be detected upon the breath, and more strongly after the lapse of half an hour than at first. But when the substance is introduced by other channels, the evidence is more conclusive. If phosphorus dissolved in oil is injected into the pleural or peritoneal cavity or into the veins, the animal exhales white vapors which are luminous in the dark. Lawrence, Harlan, and Coates found that tincture of assafœtida thrown into the peritoneal cavity or the intestine of an animal was perceptible on its breath, and a similar effect has doubtless been observed in man by all physicians after exhibiting assafœtida by enema. We have known patients to complain of its taste in the mouth after this mode of exhibition. The breath is also tainted by camphor, garlic, musk, turpentine, sulphuretted hydrogen, alcohol, and other odorous substances injected into the veins of animals.

The influence of various kinds of food upon the *milk* is notorious both in regard to quadrupeds and the human female. The color, taste, and other qualities of cow's milk and butter are well known to depend upon their grazing or fodder. Lewald found in the milk of a goat the following substances which had been mixed with its food: Iron, given in the form of muriated tincture and black oxide, bismuth, iodine and the iodide of potassium, which also augmented the secretion, arsenic, lead, zinc, antimony, and mercury. Alcohol could not be detected.[1] The bowel derangements of nursing infants are very often traceable to acid or ill-digested food used by the mother, or to causes affecting her temper or comfort. It is quite as certain that purgatives given to the mother act upon the bowels of the infant, that opium operates through the same medium, and that mercury administered to the mother will cure syphilis in the child.

But few foreign substances are found in the *saliva*, which, it must be recollected, is a secretion elaborated for the use of the economy, and not therefore fitted for conveying away unassimilable materials. When, however, the system is saturated with iodine or lead, these metals may be detected in the saliva. Some observers have reported the existence of mercury in it during salivation by this medicine, but others have searched for it unsuccessfully.

[1] Prager Vierteljahrs, lx. Anal. p. 8.

The observations and experiments which have now been described leave no possible doubt regarding the reality of the absorption of medicinal substances; for, after having been introduced at one part of the body, their operation may be suspended or moderated by ligatures or other pressure, and they may disappear from the place of application and make their appearance at another and remote one, many of them having undergone no change, while others, on the contrary, have been decomposed and formed new combinations. We have also seen that cantharides occasion strangury and otherwise derange the urinary organs, whether they are taken internally or applied to the skin; many purgatives, emetics, narcotics, etc., produce the same effects whether they are applied endermically, or taken into the stomach, or injected into the veins, and alkaline baths suspend or reverse the normal acid reaction of the urine. Indeed it is difficult to understand how any other view than one involving the absorption of medicines should ever have been regarded as exclusively true. As soon as it was known that the body grows by the absorption of food, it seems incredible that there should have been any doubt that medicines are taken in like manner into the system, and more especially that there should have been any after the discovery of the circulation of the blood. But in this case, as in others, time had gradually hardened into an inflexible body the accepted belief of many centuries; and, as it could not at once be bent or moulded anew, it was, perhaps too soon, destroyed. Yet it is strange indeed that two hundred years should have been required to accomplish so necessary a result as the substitution of the doctrine of absorption for that of sympathy.

Absorption by the Veins and Lacteals.—A knowledge of venous absorption is attributed to Celsus and Galen in the case of poisons, and certainly the latter ascribed chylous absorption to the veins. After the discovery of the lacteals, these vessels gradually became invested with the function in question, and the belief that it belonged solely to them was established fully by the experiments of Hunter, Hewson, and Cruikshank.

Hunter withdrew a loop of intestine from the abdomen of an animal, filled it with milk, and then, having first inclosed it between two ligatures, and emptied the veins by puncture, and tied the mesenteric artery which supplied the loop, he returned it into the abdomen. After the lapse of half an hour it was examined; the veins remained empty, but the lacteals were distended with milk. Similar experiments were afterwards performed with a solution of starch mixed with indigo or musk, and gave, it is said, analogous results. As early as 1791 Flandrin repeated these experiments, and in no instance detected the coloring matter in the lacteals, but observed that in very fat animals these vessels had a bluish tinge. Hallé and Fourcroy were equally unable to confirm the original observation upon this point, and so, still later, were Tiedemann and Gmelin. Drs. Harlan, Lawrence, and Coates, of Philadelphia, also concluded from their

BOSTON MEDICAL LIBRARY MAY 27 1930

experiments that "coloring matters are not absorbed by lacteals in the living body."[1]

Of various odorous substances, assafœtida alone was doubtfully recognized by its smell in the lymph. These observers, however, detected prussiate of potassa in the thoracic duct by means of the blue color produced on the addition of sulphate of iron.[2] Wagner mentions that the axillary glands of a subject, brought for dissection, were found of an intense red color, from the deposit of cinnabar in their texture, while on the arm was a red tattooed figure of old date, which had evidently furnished the material.[3] It is a familiar fact, first fully demonstrated by Ricord, that pus from a syphilitic bubo will engender syphilis if inoculated; and the same is true of glandular abscesses in other contagious diseases. But these effects are inexplicable unless we suppose the morbid virus to be conveyed from the original seat of the disease and deposited in the glands. M. Colin has shown by well-conducted experiments on the dog, the sheep, and the bull, that numerous salts introduced into the stomach or the upper part of the small intestine, *e. g.*, iodide and sulphocyanide of potassium, prussiate of potassa, tartar emetic, and alkaline arsenites, may readily be detected by appropriate reagents in the contents of the thoracic duct. His experiments also prove that the lymphatic vessels absorb such substances with equal facility. Thus, when a solution of ferrocyanide of potassium was injected into the subcutaneous cellular tissue of the face of a horse, it was detected within a few minutes afterwards in the contents of one of the lymphatic vessels lying along the carotid.[4]

But while the share of the lacteals in absorbing non-nutrient substances may be regarded as comparatively small, both by reason of their peculiar function and of their minute dimensions, the proofs that the veins possess this power are numerous and convincing. We were indebted for them originally to the ingenuity and skill of Magendie, who first published an account of his experiments in 1810. He at once took the ground that all absorption, except that of the chyle, is performed by the bloodvessels. In this, as we have seen, his original doctrine was too exclusive. The later discoveries of Dutrochet, relative to the permeability of membranes, pointed to the mechanism by which soluble substances are enabled to enter the circulation. Magendie showed that tincture of nux vomica applied to a vein, completely isolated by means of a card placed behind it, produced the characteristic symptoms of poisoning by this substance, in the course of a few minutes. When an artery was treated in like manner, the result was the same, but occurred more tardily. Mayer, within three minutes after a solution of prussiate of potassa was injected into the air-tubes of an animal, detected its presence in the left ventricle of the heart, but not in the right. If the absorption of the liquid had taken place by the lymphatics, it would have shown

[1] Philad. Journ. of Med. and Phys. Sci., iii. 284.
[2] Ibid., v. 347.
[3] Todd and Bowman's Physiology (Am. ed.), p. 619.
[4] Bull. de l'Acad. de Méd. xxvii. 948.

its presence first upon the right side of the heart into which these vessels empty.[1] In this connection must also be cited the well-known experiment of Magendie. The limb of an animal remaining attached to its body only by an artery and vein, a ligature was placed upon the latter, and strychnia applied to a wound in the limb. No symptoms of poisoning were manifested until the ligature upon the vein was removed, but on this being done, characteristic effects were immediately developed. A similar experiment, in which prussic acid was the poison employed, and the intestine of a horse the part to which it was applied, was performed by Panizza with identical results.[2] Sir E. Home tied the thoracic duct of a rabbit at its entrance into the subclavian vein, and gave the animal a strong infusion of rhubarb. An hour and a quarter afterwards the urine showed evidences of the presence of the medicine. Magendie performed the same experiment, with this difference, that he injected a strong solution of upas tieuté into the peritoneal cavity. The effect was quite as rapid as when the duct remained free. To these experiments others might be added, particularly those of Dr. Nathan Smith, at Philadelphia, in 1827, showing that the lymphatics of the stomach do not absorb a solution of prussiate of potassa, but that it enters freely into the veins.

On the whole, it is evident that, although both lymphatics and veins absorb medicinal substances, this office belongs principally to the veins. Not only are the latter vessels vastly more capacious than the former, but, considering that the quality of the fluid circulated by them is so much denser than that which traverses the lymphatics, it might naturally be inferred that the veins are best adapted for conveying non-assimilable, and therefore comparatively gross substances. The lacteals are evidently intended to elaborate the products of digestion before they enter into the blood; but it would answer no good purpose, that we know of, for medicinal substances to undergo this operation. These, we repeat it, appear to be absorbed in by far the greatest proportion by the veins.

Conditions for the Absorption of Medicines.—As a rule, substances in solution are alone absorbed. They are either administered in this form, or they become dissolved in the primæ viæ by the operation of the gastro-intestinal secretions. In so far as the activity of a medicine depends upon its solution, it is evident that, if administered in the solid form, so much of it only will affect the economy as shall be rendered absorbable by being dissolved in the secretions of the stomach and bowels. The residue will act as a foreign body, and will either be discharged with the feces, or, remaining partially behind, it may be increased by repeated doses, and at last become a mechanical impediment to digestion. Magnesia, carbonate of iron, and mustard seed have been known to form large intestinal concretions. In view of this inconvenience and danger,

[1] Albers, op. cit., p. 221.
[2] Am. Journ. of Med. Sci., Jan. 1844, p. 187.

it has been proposed to administer all medicines in such a state of solution as will insure their direct absorption without precipitation. But, apart from the practical difficulty, if not impossibility, of securing this condition, it is probable that no state of solution is so favorable to the absorption of a medicine as its union with the organic solvents it meets with in the body, and that no other solvents will be so apt to produce a solution as well adapted to the purposes of the economy as those referred to. Thus calomel, given as a purge, which it certainly does not become by virtue of any merely irritant properties, has an action which cannot be imitated by the use of any soluble salt whatever of mercury. Moreover, the rapid absorption of a medicine is very far from being always desirable. Its slow and gradual operation is often one of the conditions of its curative influence.

It has been supposed that minutely divided, but insoluble substances, are to some extent capable of absorption. So Œsterlen[1] administered to rabbits, a cat, and two pullets, very finely pulverized charcoal mixed with water and their food. After the animals had been thus fed for a week, they were killed, and under the microscope particles of charcoal were found in the blood of the mesenteric and other veins of the trunk. These experiments were repeated by Mensonides, who likewise detected the particles of charcoal, especially in the lungs.[2] But Mr. Headland, who, however, did not employ charcoal in his experiments, came to the conclusion that "no insoluble medicine can in any way gain entry into the blood without first undergoing solution in some way or other."[3] Mr. Lister, who used indigo, carmine, and flowers of sulphur in his experiments, declares that none of these substances enter the *lacteals*.[4] It is probably true, for all practical purposes, that insoluble substances are not susceptible of absorption, even if we should admit the accuracy of Œsterlen's observation. But what, after all, is solution but a minuter division of particles than is attainable by any mechanical process? It is possible that the particles of charcoal are capable of being reduced to minuter dimensions than those of other insoluble substances, and that they are thus enabled to enter the pores of the veins. In connection with this subject, the absorption of metallic mercury by the skin, which has been already described, should not be forgotten. But in that case, the metal, in the form of an ointment, is forced by a mechanical process—friction—between the cells of the epidermis and the fibres of the true skin.

A few remarks concerning the hindrances to the absorption of medicines will not be misplaced here.

The thickness of the skin influences its absorbent power. This function is naturally most active where the cutis is most delicate, as on the inside of the thighs and arms, and the anterior surface

[1] Arch. Gén., 4ème sér., xvii. 472. [2] Ibid., xx. 80.
[3] The Action of Medicines, p. 76.
[4] Dub. Hosp. Gaz., and Am. Journ. of Med. Sci., July, 1858, p. 195.

of the trunk. When the integument is thickened by chronic disease, as ichthyosis, psoriasis, elephantiasis, etc., it absorbs imperfectly; and also when it has the doughy feel and sluggish vitality observed in persons of a marked lymphatic constitution. When a limb is paralyzed, its absorbent power is diminished; this is particularly noticeable when irritants, such as ammonia or cantharides, are applied to it. The presence of food in the stomach, or of dirt upon the skin, lessens the activity of these parts as absorbing organs: on this account, many poisons, taken when the stomach is full, produce comparatively slight symptoms; and hence also the precept to cleanse the skin throughly when the iatroliptic method is employed. Not only does paralysis of a part impair its absorbing power, but the vital activity may be temporarily increased elsewhere. When the brain is excited by thought, especially of a painful kind, the action of the stomach and bowels is impaired, digestion and defecation are suspended, and medicines administered by these organs operate imperfectly. The same statement is true in regard to certain affections of the brain and spinal marrow, of which obstinate constipation and general insensibility to the impression of medicines are among the most prominent symptoms. That such large doses of opium can be borne in mania-a-potu, and in tetanus, is probably due, in part at least, to the fact that the medicine is not absorbed. In the former disease, an emetic or a purgative appears to increase the susceptibility to narcotics. If the nervous system is oppressed by a mechanical pressure on the brain, or droops for want of a stimulant power in the blood, absorption is generally impaired, and medicines operate slowly and imperfectly. According to Casper, parts which are most immediately dependent upon the brain are most affected in their absorbent power by its diseases, and he states that, in these diseases, the administration of medicines by the rectum is more efficient than by the stomach. Dupuytren found that, in traumatic delirium, opium in clyster was more operative than opium by the mouth; and Casper says that the same is true in typhus. If he gave opium by the mouth, its effects were not perceptible for several days, but by the rectum it displayed its influence in a few hours. Or, if opium had been administered several times by the mouth, without preceptible effect, and an injection of laudanum was then administered, the resulting narcotic influence was apt to be excessive, because, meanwhile, the doses in the stomach had begun to act, the brain having been freed from its oppression through the influence of the dose administered by the rectum. In cholera, the vital powers of the digestive canal are so impaired, and the tendency to exhalation so completely neutralizes the absorbent function, that neither food nor medicine undergoes either digestion or absorption. A somewhat similar condition exists in the disease called lientery, although in this case medicine appears to be more susceptible than food of being absorbed. At the two extremes of life, the function of absorption displays opposite degrees of activity; it is excessive in infancy, and deficient in old age. On this account, chiefly, the average doses of medi-

cines for adults must be greatly diminished for children, and, with the exceptions elsewhere stated, somewhat increased for the aged.

THE AVENUES BY WHICH MEDICINES ARE INTRODUCED, AND THE VARIOUS EFFECTS WHICH THEY PRODUCE.—It has already been shown that almost every part of the body is capable of absorbing medicinal substances, but, as some tissues possess the power in a greater degree than others, or in practice may be more conveniently employed as absorbing surfaces, we shall next inquire what these are, and the peculiarities of their relations to medicinal substances. The veins, the mucous surface of the tongue, mouth, and lungs, the stomach, rectum, bladder, vagina, the eyes, ears, and nostrils, the skin and the cellular tissue, are the principal parts to which medicines have been applied. When brought into contact with several of the organs, they are apt to undergo a change of composition or activity, in consequence of their chemical relations to the tissues or their secretions, and also to be more or less absorbed, in proportion to their solubility. The nervous associations of the organ chiefly acted upon will also determine, in some degree, the operation of the medicine.

Infusion, or the Injection of Medicines into the Veins.—This mode of applying medicines was used as early as the beginning of the 17th century. In the *Philosophical Transactions*, there is an account of the injection, by Dr. Fabritius, of two drachms of a laxative medicine into the median vein of the right arm of three patients in the hospital at Dantzick. In the comments on this narrative, it is said that "the dangerousness of the practice has justly brought it into disuse."[1] In the *Boylston Prize Essay*, for 1821, the late Dr. Enoch Hale describes the effects produced in his own person by injecting half an ounce of castor oil into the median vein. In about half an hour he perceived an oily taste in his mouth, with slight nausea, eructations, some commotion in the bowels, an "indescribable feeling which seemed very suddenly to ascend to his head, with sudden stiffness of the jaws, and slight faintness." The abdominal disturbance, with pain, continued, but no evacuation took place, although there was a strong desire to go to stool.[2] But, although Scheel, Dieffenbach, Burdach, and others have also employed this method, the cases in which it is now recommended are comparatively few. They are these: when death, without prompt relief, is inevitable, and the ordinary means are useless; when foreign bodies become so wedged in the œsophagus as to obstruct its passage; in cases of asphyxia; insensibility from narcotic poisons or from alcohol; tetanus; hydrophobia; the collapse of malignant cholera, etc. In a certain number of cases of obstruction of the œsophagus by a foreign body, the injection of tartar emetic into the veins has provoked vomiting, which expelled the obstruction. In cholera, the blood becomes thick from the loss of serum, and saline solutions injected into the

[1] Phil. Trans., abridged, 1745, i. 23.
[2] Boylston Prize Dissertations, 1821, p. 117.

veins have, in some instances, restored its fluidity, but rarely been the means of saving life. Weak saline liquids alone are suitable for this operation. It is quite possible that if the operation could be performed early, and kept up for an indefinite period, or until the morbid actions on the surface of the stomach and intestines had ceased, life need seldom be lost by cholera. It seems always to destroy life by robbing the body of that which is essential to life—water.

These results have been confirmed by the experiments of Mr. L. S. Little, in London. Instead of employing a syringe to inject the fluid into the veins, he used the force of gravity. A zinc vessel was employed, holding about eighty ounces, with a lamp underneath, a thermometer hanging within, and a tap near the bottom, from which proceeded an India-rubber tube four feet long, with a silver nozzle at its end. If difficulty was experienced in introducing the nozzle, the vein was freely exposed, supported on a probe, and incised longitudinally. The liquid employed consisted of chloride of sodium 60 grs., chloride of potassium 6 grs., phosphate of soda 3 grs., carbonate of soda 20 grs., alcohol 2 drachms, and distilled water 20 ounces. The alcohol was added only when the liquid was about to be used; and the temperature of the latter was not allowed to exceed 110° or to fall below 100°. Five out of twenty apparently hopeless cases recovered under this treatment. The first effect of the injection was to restore the pulse, which had ceased to be felt; the voice also was restored, the color and expression improved, the cramps were relieved, the temperature rose, and the patients became convinced that their recovery was assured. A profuse perspiration and a severe rigor accompanied these symptoms. The rigor was evidently a nervous phenomenon, and not a chill, for it occurred while the temperature was rising.[1]

Transfusion is an operation by which the blood of one animal is conveyed into the bloodvessels of another animal. It may either be direct, as when the vessels of the two animals are immediately connected by a tube, or indirect, as when blood drawn from one is injected by means of a syringe or other instrument into the vessels of the other. The latter operation is sometimes called *infusion.* Traces of this method may be found in various ancient authors who refer to its use for rejuvenating the old. Thus Ovid says—

> "veteremque haurite cruorem
> Ut repleam vacuas juvenili sanguine venas."—*Metaph.*, lib. vii.

The operation was described by Libavius early in the seventeenth century as being used to rejuvenate the old and decrepid by the blood of the young;[2] and about 1660–70 it was certainly performed with the blood of the lower animals upon those of their own species, and upon man, by Denis in Paris, and by Lower and King in England,

[1] Times and Gaz., April, 1867, p. 354.

[2] Ullersperger, Prize Essay, Trans. Med. Soc. Penn., 1867.

and by Daniel in Germany, and indeed by many others.[1] Owing to the ill success of an operation performed by Denis he was prosecuted in 1668 as having contributed to occasion his patient's death. A similar incident occurred at Rome, and thenceforth transfusion fell into ill repute, and was neglected until the experiments of Leacock, of Barbadoes, published in his Inaugural Essay in Edinburgh, led Dr. Blundell to institute similar ones in London, in 1817,[2] and afterwards to pursue them upon the human species,[3] but at first without successful results in the latter case. Soon afterwards, however, the operation was successfully performed by Mr. Waller, under Dr. Blundell's direction, in a case of flooding;[4] and in two similar cases[5] by Mr. Doubleday and by Dr. Uwins. About the same time Prevost and Dumas proposed the use of defibrinated blood and thus removed a chief hindrance to the success of the operation. Their conclusions were confirmed by Bischoff, Polli, Brown-Séquard, and especially by Panum and by De Belina, who showed that the presence of fibrin was not only a mechanical hindrance in transfusion, but unnecessary for the purposes of the operation. Blundell had already proved that considerable quantities of air might be injected into the veins of an animal's limbs without seriously affecting it, and Loewenthal[6] confirmed this observation by numerous experiments, while by others he demonstrated that similar injections into the jugular veins, and into them alone, were promptly fatal by producing embolism of the branches of the pulmonary artery, and thence cessation of the circulation through the lungs and left side of the heart, while the right side of that organ and the veins leading to it were distended with blood. The indications for transfusion are, in general terms, all those conditions in which the blood is unable to maintain life, owing either to its insufficient quantity or its deteriorated quality. The former is of course usually due to hemorrhage, whether from accidental traumatic causes or surgical operations, from the accidents of child-birth, or from diseases such as ulcers of the stomach or bowels, or from those which occasion hemorrhage, such as cancer. In the last-mentioned affection and other similar incurable ones it need scarcely be mentioned that the operation is justifiable only when it is invoked to remedy the damage occasioned by a sudden and profuse loss of blood. In regard to the utility of the operation in cases of deterioration of the blood by morbid poisons, the evidence is less favorable, if, indeed, it is at all encouraging; but when life is in jeopardy from poisonous gases and even from narcotic poisons the operation has sometimes preserved it.

[1] Oré. Transfusion du Sang, Paris, 1867; Leisrink, Ueber die Transfusion des Blutes, Leipzig, 1872.
[2] Med.-Chir. Trans., ix. 56.
[3] Researches Physiolog. and Pathol., London, 1825.
[4] Lancet, September, 1825, p. 342.
[5] Ibid., October and November, 1825, p. 111 and p. 295.
[6] Transfusion des Blutes, Heidelberg, 1871.

In 1841 Mr. Peet showed that the operation is uniformly unsuccessful after respiration has ceased, and that the cases in which it is most useful are those of exhaustion by hemorrhage.[1] In 1852 Mr. Soden published an analysis of 36 cases of hemorrhage or exhaustion connected with the puerperal state, in 29 of which the remedy was used successfully.[2] Of more recent cases are one by Desgranges,[3] seven by Mr. Higginson,[4] two by Mr. Wheatcroft, etc.[5]

Dr. Ladislas de Belina, in his Essay upon this subject,[6] states that the operation has been successful in 87 out of 175 cases, and immediately fatal in two. In both of these cases the injection was made by the jugular vein, and the introduction of air occasioned the result. In a third case death by asphyxia resulted apparently from the introduction of fragments of coagulated blood. In five cases phlebitis followed, but was fatal in one case only. Frequently the patients suffered from headache, dyspnœa, oppression, palpitation of the heart, and strong carotid pulsations; in seven cases there were convulsions, rigors in three, and vomiting with transient collapse in two. The most successful cases were those of *post-partum* hemorrhage; of these, 56 recovered and 29 died. In traumatic hemorrhage and that from neoplastic tumors, the cases of death and recovery were about equally divided. In various alterations of the blood 24 cases were successful and 39 fatal. In 1871 Mr. Higginson published a summary of thirteen cases of transfusion, of which six, all of them cases of hemorrhage, recovered.[7]

The operation of transfusion, if properly performed, is not dangerous. It is true that it must often be required when the most appropriate apparatus is not within reach, and in such cases a simple tube and an ordinary syringe have often sufficed. The best instruments are so made as to prevent the injection of air or of coagulated blood. The blood should, indeed, be always strained through fine muslin or lace. The instrument should not be liable to become clogged, and its piston should be worked by a screw, the more effectually to overcome resistance and to insure the gradual introduction of the liquid. Dr. Hicks[8] has proposed to prevent the coagulation of the blood used in transfusion by mixing with it one-fourth of its bulk of a solution made by dissolving three ounces of phosphate of soda in a pint of water. The cases in which this liquid was used by him were all fatal, although the blood did not coagulate during the operation.

The Stomach.—The stomach is the organ best adapted by nature, and the one most usually employed for the introduction of medicines into the body. When empty, its absorbent power is most

[1] Lancet, November 1841, p. 305. [2] Med.-Chir. Trans., xxxv. 413.
[3] Bull. de Thérap., xlii. 134.
[4] Liverpool Med.-Chir. Journ., Jan. 1857, p. 102.
[5] Lancet, October, 1857, p. 354 and p. 443.
[6] Archives de Physiologie, 1870, p. 43 and p. 463.
[7] Liverpool Med. and Surg. Reports, v. 104.
[8] Guy's Hospital Rep., 3d Ser., xiv. p. 1.

active, and it is especially so in the morning, before breakfast. But when the organ contains food, not only is the absorption of medicinal substances mixed with the food delayed, but they are apt to form with it new compounds. This is the case with metallic salts and oxides. Such of these as have a caustic operation, and which in large doses act as irritant poisons, may exert but little influence when the stomach is filled with food. Owing to torpor of this organ, produced by local disease, general febrile disorder, or imperfect excitability of the nervous centres, or, on the other hand, in consequence of a morbid susceptibility of the stomach itself, medicines may be either slowly and imperfectly absorbed, or rejected by vomiting. In the former class of cases, it is necessary to combine stimulants with them, to make irritant applications to the epigastrium, or to administer stimulant enemata; and in the latter to associate the medicine with opiates or sedatives, or by means of a revulsive action on the epigastrium, or the hypodermic use of a salt of morphia, or by some equivalent measure, to reduce the susceptibility of the stomach to a proper point.

Liquid medicines act most promptly, as a general rule, when given by the stomach. Water and alcohol are entirely absorbed by this organ, and with them many substances which they are used to hold in solution. The more diluted the latter is, the more rapidly is the liquid absorbed. Hence natural saline mineral waters are much more active than is the quantity of solid ingredients they contain, when it is given in a denser artificial solution. The absorption of solid medicines depends almost altogether upon their degree of solubility in the gastro-intestinal secretions. Mineral substances, insoluble in water, are often made extremely soluble by means of the gastric acids. This is eminently the case with iron, mercury, magnesia, etc. Other medicines, which are unaffected by organic acids, dissolve under the influence of the alkaline secretions of the pancreas and liver. Sulphur and iodine are said to belong to this category, and all fixed oils and fatty substances are emulsified by these secretions before being absorbed by the lacteals. The same alkaline menstruum dissolves resinous substances, such as catechu, kino, benzoin, copaiba, guaiacum, etc., and many other active principles, *e. g.*, creasote, cantharidin, piperin, elaterin, capsicin, etc. Volatile oils are said to become oxidized and converted into resins by the gastric juice, and thus to become soluble in water. Thus turpentine changes into common resin (which consists of two isomeric acids, pinic and sylvic), and is then dissolved by the pancreatic juice. Vegetable substances soluble in water, as sugar, vegetable acids, the natural salts of the vegetable alkaloids, and neutral soluble principles not partaking of the nature of alkaloids, such as emetin, caffein, salicin, and the soluble active principles of senna, aloes, and gentian, with atropia, daturia, hyoscyamia, conia, and nicotia, are all absorbed with facility. Among other soluble products of the vegetable kingdom may be enumerated alcoholic and ethereal fluids.[1]

[1] HEADLAND, The Action of Medicines, p. 61, etc.

On account of the sympathetic connections of the stomach with the rest of the system, this organ is often selected for awakening salutary actions in the whole economy by an impression made upon itself. This is particularly the case when emetics are administered for the purpose of exciting perspiration, promoting secretion, relieving the head of congestion, the air passages of obstructions, etc. It is also to be noticed that most of the individual peculiarities in regard to the action of medicines relate to such as are developed when they are administered by the stomach. In it, and in the intestinal canal, are generally contained those accumulations of vitiated secretions which frequently become the original cause of disease, or which assist in maintaining it, and which must modify the operation of medicines.

The Rectum.—The secretions of the rectum, unlike those of the stomach, are generally alkaline, and consequently many medicines which are readily absorbed after undergoing decomposition by the gastric acids, are not adapted to affect the system when administered by the rectum. Such is the case with acetate of lead, the greater part of which, when given by injection, exerts only a local action. Still more strikingly is this the case with food, and hence the impossibility of long sustaining life by means of nutritious enemata. Other substances which are susceptible of absorption without change, may exert their peculiar influence through this channel. Bulky medicines, and those of an irritating or stimulating quality, are not adapted for this mode of administration, because they are apt to be speedily rejected, and also because the absorbing surface of the rectum, even if it were equally active with that of the stomach, is more limited in extent. Moreover, the sympathetic relations of the former organ are vastly inferior to those of the latter. In regard to the capacity of the rectum for the absorption of nutriment, there are probably cases in which this function, however limited, may be made of great service; as where from the refusal of a patient to swallow food, extreme irritability of the stomach, or other incapacity of this organ of a temporary nature, and also obstruction of the bowel, life may be prolonged until the return of a more natural state of things permits the administration of food by the mouth. Cases of the kind are related by Mr. Henry Smith of London.[1]

It is generally believed that the absorption of medicines by the rectum is much less active than by the mouth, and consequently, that the dose should be greater by the former than by the latter. Richter and Pereira say that it should be five times, and Trousseau, Albers, and Dr. Wood, that it should be two or three times greater. On the other hand, Orfila and Dupuy, and, following them, Mérat and Delens, Bouchardat, and other French therapeutists, assert that the dose by the rectum, and especially of narcotics and medicines soluble in water, should be less than that administered by the mouth. Spillan places narcotics under the latter rule, but acrid

[1] Med. Times and Gaz., June, 1853, p. 626.

substances under the former. Others, again, will have it that the dose should be the same in both cases. M. Briquet states that sulphate of quinia, given by enema, has the same effect by the rectum as by the mouth, provided the dose do not exceed fifteen grains.[1] On the other hand, Restelli affirms of the salts of strychnia and morphia dissolved in alcohol, that in animals these substances are more speedily poisonous, and in smaller doses, when thrown into the bowel than into the stomach.[2] Dupuytren maintained that narcotic medicines are more operative by the rectum than by the mouth. "It is easy to understand," he remarks, "for medicines are not changed by the action of the rectum as they are by that of the stomach."[3] Galtier cites the experiments of Roselli and Strambio with strychnia as proving that this poison acts more rapidly by the rectum than by the stomach, and includes in the same category opiates and preparations of the Solanaceæ.[4] Dr. Anstie concludes from his experiments, that for all soluble substances the rectum forms quite as effective a channel as the stomach; and as regards morphia, that in his own person its appropriate effects were produced more rapidly through the rectum than when it was given by the stomach.[5] The experiments of Demarquay with iodide of potassium prove that this salt is more rapidly absorbed by the rectum than by the stomach. The most thorough investigation of this subject has been made by Mr. Savory. He arrived at the striking and unexpected result that the substances of the same general class are absorbed by the two organs in question with various degrees of rapidity, and that in no instance did the absorbing power of the stomach greatly exceed that of the rectum. The most remarkable difference was observed in the case of strychnia in solution, which developed its appropriate phenomena three or four times more rapidly in some experiments when it was administered by the rectum than when it was given by the mouth. The time required for occasioning the characteristic effects of cyanide of potassium and hydrocyanic acid was nearly the same by either mode of operating, while nicotine acted a little more rapidly by the mouth.[6] We have already remarked on the relative solubility of medicinal substances in the secretions of the stomach and rectum as affecting their rate of absorption. Mr. Savory mentions a fact in relation to strychnia which is confirmatory of this statement, viz., that strychnia acts more promptly by the stomach than by the rectum when it is in the solid form, a circumstance unquestionably due to the solvent power of the gastric juice. These discordant facts and opinions should suggest a cautious use of powerful medicines by means of enemata.

Medicines are also administered by the rectum when an obstruction to swallowing exists in the mouth or œsophagus, when the stomach

[1] Bull. de l'Acad. de Méd., xxii. 237. [2] Annuaire de Thérap., 1848, p. 223.
[3] Leçons Orales, ii. 301. Brussels ed., 1839.
[4] Traité de Toxicologie générale, p. 8, Paris, 1855.
[5] Med. Times and Gaz., Mar. 1863, p. 334.
[6] Lancet, May, 1863, pp. 515, 548.

is irritable, or when the disease occupies the large intestine, bladder, uterus, or other pelvic organ. Stimulant enemata, as of spirits of turpentine, are often used for their direct operation as well as for their derivative action upon the brain. Suppositories are introduced into the rectum containing narcotic or astringent substances, intended to act upon that bowel or the adjacent parts, as well as upon the general system; and occasionally vapors, such as tobacco smoke, carbonic acid gas, and the vapor of chloroform or ether, are injected to overcome spasm, or to relieve pain. Whenever this method is resorted to, the rectum should first be thoroughly cleansed by means of enemata of tepid water.

The Vagina.—In its healthy condition, the absorbing power of the vaginal mucous membrane does not appear to be very great; yet it frequently happens that even without any lesion of this membrane suppositories used for their local influence merely, occasion their characteristic effects upon the nervous system. When ulceration of the neck of the womb exists, these effects may occur in an exaggerated and even alarming degree.

The Mouth and Fauces.—To these and the adjacent parts, medicines are seldom applied, except for the relief of local disorders, such as neuralgic or inflammatory toothache, ulcers, aphthæ, false membranes, suppuration of the nasal passages, of the tonsils, pharynx, Eustachian tube, etc. Sternutatories are applied to the nostrils, and various stimulants intended to rouse the brain in cases of syncope; masticatories are used to excite the secretion of the salivary and other glands supplying the buccal cavity. The mucous membrane of this part has been made use of for introducing mercury, and also gold, by friction, but without evident reason or approved advantage.

The Skin.—Medicines are applied to the skin, both when the cuticle is sound, and also when it has been removed by vesication, in order to make a revulsive impression, to produce a local alteration, or to affect the economy by their absorption.

It was anciently the custom to anoint the skin with medicated oil, and to apply various anodyne and discutient plasters to affected parts. Theophrastus relates that strong scented cataplasms applied to the stomach impart their odor to the eructations. More recently the treatment of syphilis by mercurial inunctions, and the long known fact that blisters of cantharides produce strangury, although they were most striking illustrations of absorption, do not appear to have suggested the existence of this function until after the discovery of the lymphatics. In 1787, Assalini, in his Treatise on the Lymphatics, alluded to the power of the skin to absorb watery vapor charged with medicinal substances, and in a much later work adduced copious illustrations of cutaneous absorption.[1] Some of the earliest proofs of cuticular absorption were furnished by physicians of

[1] Ricerche mediche su i bagni di vapore, etc., Napoli, 1820.

Philadelphia. The experiments and arguments of Dr. Mussey, of Drs. Coxe, Joseph Klapp, H. Rousseau, and S. B. Smith, of this city, and those of Dr. J. B. Stuart, of Albany, went far to establish the fundamental facts on which this doctrine rests.[1] They showed that certain coloring and odorous matters applied to the skin affect the breath or the urine. Attempts to elucidate this subject were resumed at a later period. Dr. Dill, of Edinburgh, showed that in a warm bath (86° to 102° F.), the body generally, but not uniformly, increases in weight.[2] This trial does not always result in the same manner, as Dr. Dill's own experiments, and those of Dr. James Murray, with baths at a temperature between 88° and 104° F., clearly show.[3] The latter gentleman proved, by tests applied to the urine, that gallic acid is absorbed by a person immersed in a bath containing infusion of galls. Prussiate of potassa was found, by Westrumb, in the blood and urine of persons who had used foot-baths containing this salt, and the urine, as well as the serum of the blood, was colored brown when the arms were kept immersed in an infusion of rhubarb.[4]

The more recent experiments of Duriau, while they tend to reconcile some of the contradictory results above referred to, throw doubt upon the power of the epidermis to transmit several medicinal substances usually supposed to have a peculiar facility of penetration.[5] By these experiments, it is rendered clear that for every person there is a temperature at which the body immersed in water neither gains nor loses in weight; while, on the one hand, above this point it exhales more than it absorbs, and, therefore, becomes lighter, and, on the other hand, below this point it absorbs more than it exhales, and grows heavier. Thus, in a bath of from 72° to 77° F., the skin *absorbs*, on an average, 248 grains in a quarter of an hour, 442 grains in three-quarters of an hour, and nearly 700 grains in an hour and a quarter. On the other hand, in baths of an average temperature of 97° F., the body *loses* in weight at the rate of 744 grains in 15 minutes, 1271 grains in 30 minutes, and 2054 grains in 45 minutes. In a bath of 113° F., the body lost more than a pound in weight in the course of fifteen minutes. By this simple statement it becomes evident that, in the case of water, exhalation is a more active function of the skin by far than absorption.

M. Duriau attempts to prove that the epidermis imbibes liquids of a proper density, in virtue of a purely physical property, but that it does not very readily permit them to traverse it. This is shown by its retaining so perfectly the serum of blisters, and bullæ, and vesicles. Whatever liquids are absorbed by the true skin must first reach it through the epidermis by imbibition. In M. Duriau's experiments with prolonged baths containing iodide, carbonate, nitrate, or prussiate of potassa, common salt, sulphate of magnesia, or alum,

[1] Med. Museum, i. 14, 34; vi. 55, 209, 227.
[2] Trans. Med. Soc. Edinb., ii. 363 (1826).
[3] The Influence of Heat and Humidity, Lond., 1859, p. 141. See, also, Art. CALOR.
[4] Journ. des Progrès, 1828, xi. 13.
[5] Archives Gén., Fev. 1856, p. 161.

and at a temperature varying from 86° to 93° F., none of these substances could be detected in the urine. In this result there is nothing surprising, for the temperature of the baths used was considerably higher than that which is assigned above as the most favorable to cutaneous absorption, viz., 72° to 77° F. A similar remark is applicable to the experiments of M. L. Parisot,[1] who employed baths of a temperature between 82° and 86° F. These experiments have, therefore, no real bearing upon the question of medicinal absorption. The same remark is applicable to the numerous careful experiments of M. Willemin. Although he concludes that in baths of a temperature between 89° and 94° F., the skin *appears* to absorb water, he shows that under the circumstances the phenomenon is by no means constant. But even at this temperature he found in the urine soluble substances introduced into the baths, such as the iodide and the cyanide of potassium.[2] On the other hand, Dr. Murray Thomson failed to detect the former of these compounds in his urine after baths of 90° to 100° F. But as he was also unable to detect the iodide of potassium in the same excretion even after swallowing any quantity less than two grains of this salt, or the ferrocyanide, if less than five grains were taken, it is quite possible that his skin may have absorbed a certain quantity of these compounds less than those indicated and quite sufficient to act medicinally.[3] It must also be observed that a considerable quantity of iodide of potassium was used in the experiments of Willemin. When less than one hundred and fifty grains of this salt was dissolved in the bath, it failed to furnish any evidence of its presence in the urine.

The following experiments of Hoffman show that the time during which a medicine is applied to the skin influences its absorption strikingly: "1. During 44 days I took 16 baths, each containing 300 litres of water and 250 grammes of digitalis leaves. After the third bath only I began to feel the peculiar uneasiness proper to the action of the medicine; my pulse at the same time became slower by four or five beats, and this condition persisted for several hours. By the eighth bath the malaise had increased, and my pulse had descended from its ordinary rate of 68 to 61, while after the sixteenth bath it had descended to 48. It is evident, then, that the active principles of digitalis had been absorbed, but only in a slow and progressive manner. 2. Every third day during six weeks I took a bath, to which 50 grammes of iodide of potassium had been added. After the fifth bath I recognized the presence of the iodide in the urine, and this condition persisted for twelve days after all treatment had ceased, excretion being, in this case, as slow as the absorption. 3. A bath was taken every third day during a month, to which 5 kilogrammes of sea salt had been added, and the chlorides of the urine rose progressively from 2.15 grs. to 3.47 grs. per

[1] Bull. de Thér., lxv. 284. [2] Archives Gén., July—September, 1863.
[3] Edinb. Med. Journ., May, 1862, p. 1019. In this paper a summary is furnished of opinions and experiments opposed to and in favor of the doctrine of cuticular absorption.

litre."[1] It is an interesting, and probably an important fact, that in every case the urine becomes alkaline during the use of the warm bath; and that this change does not depend alone, if at all, upon the absorption of any saline base, is proved by the same effect ensuing when nitric acid or sulphate of quinia is dissolved in the bath instead of the alkaline salt.

The results of Hoffman's experiments with digitalis have been confirmed by Chrzonzewski, of Berlin. A lad of fifteen remained for six hours in a sitz-bath made by infusing half a pound of digitalis in four pails of water at 95° F. While he was in the bath no sensible effects were produced, but at the end of fourteen hours the pulse fell from 84 to 60, and both head and stomach were disordered. These effects did not disappear for two days.[2] The absorption of iodide of potassium from baths by the skin was found by Hoffman, as before stated, to be very gradual, and this is, no doubt, the reason why several experimenters, including Roussin, Ritter, Oré, and Demarquay, have denied altogether the cutaneous absorption of that salt. Roussin and Scoutetten both proved its absorption in a large proportion when a shirt soaked in a strong solution of it and then dried, or a cotton compress prepared in the same way, was worn next the skin. These results have led to the general conclusion that when watery solutions are not absorbed by the skin it is simply because they cannot come into actual contact with it. The unctuous coating effectually keeps at a distance all watery liquids, while the very substances dissolved in them may readily unite with it, and thus acquire the best physical conditions for absorption, provided they are applied in such a form as to favor their union with the sebaceous secretion.

The above experiments are not in conflict with, but are rather supplementary to, the results of earlier observations, which prove that coloring, odorous, and other vegetable principles and animal substances may enter the economy by cutaneous absorption. All those which it has before been said operate by penetration prove this to be true. Cantharides, mustard, ammonia, chloroform, ether, mezereon, turpentine, narcotic extracts, and many other substances penetrate the epidermis, and act upon the chorion, and if they are not then absorbed into the circulation it is not because the epidermis forms a barrier to their admission. All of these substances except the last are irritants of the skin, a fact which probably goes far to explain their absorption by this organ. This, at least, appears to be strikingly true of chloroform. In a very interesting series of experiments by Dr. Waller, of Birmingham,[3] it is shown that when the limb of a young guinea pig or of a white rat is immersed in tincture of aconite or belladonna, or in an alcoholic or aqueous solution of atropia, morphia, or strychnia, the

[1] Times and Gazette, April, 1867, p. 419. Demarquay has called attention to a circumstance which qualifies the results of these experiments. He has shown that integument of the glans penis, and of the anus, which is exceptionally delicate, will absorb medicated solutions much more freely than other portions of the skin.

[2] Prager Vierteljarsch. 110; Analect, 17.

[3] Am. Journ. of Med. Sci., Jan. 1860, p. 213.

effects are very slight, and also very slow in making their appearance, while the same agents dissolved in chloroform produce their characteristic effects with great rapidity, and at the same time the skin is decidedly irritated by the excipient.

Although mere contact is sufficient to induce the absorption of some medicines by the skin, this function is rendered much more active when they are mechanically forced through the epidermis by friction. It must be remembered that the outer layers of this membrane consist of dry and flattened cells or scales, between which the operation referred to forces the medicinal substance, and brings it immediately in contact with the actively absorbing tissue which lies beneath. In this manner, only, can be explained the actual disappearance of unctuous and liquid medicines applied by friction to the skin, and the discovery of mercury in the deeper layers of the skin, and in the peritoneal cavity after it has been rubbed into the integuments. It is worthy of remark that the metal, if oxidized in the ointment, becomes deoxidized during its transit. This mode of application was systematized by Chrestien,[1] under the name of the *iatroliptic* method (ιατρεύω, I cure, ἀλείφω, I anoint), and employed by him in a great variety of affections, and with very many medicines. Fat, oil, and alcoholic liquids are used as vehicles for the latter; soap liniment is one of the best, and the friction should be made steadily for five, ten, or even twenty minutes, and until all of the substance employed has disappeared. Mercury is the medicine most frequently applied in this manner, but iodine, camphor, and various narcotics are occasionally used. As it is not only by vital absorption, but also by penetration, that the medicines thus applied become efficient, the required frictions should be made as near as possible to the affected part, and with such gentleness as to avoid bruising it. Or, if it is intended to affect the whole system by causing the absorption of the medicine, a part should be selected where the skin is delicate, smooth, and free from hair. Such are the inner surface of the arms and thighs, the sides of the neck and chest, and the groins. The state of the part influences, in some degree, the action of medicines applied to it. This is generally greatest when the skin has been thoroughly cleansed, and also softened by warm and moist applications, and when the liquid or substance employed is also of a suitable temperature. An inflamed skin absorbs but little. Besides the frictions now described, medicines are often used to act upon the skin by mere contact. Baths, both general and local, lotions, fomentations, and poultices, which in their simplest forms are merely vehicles of heat and moisture, are often also medicated, that is to say, they contain substances which act as stimulants, sedatives, anodynes, or alteratives. Of these may be mentioned, as examples, sinapisms, poultices containing various herbs yielding essential oils (labiatæ), narcotic extracts, lead water, etc.; ointments and lotions holding irritants in solution, such as cantharides, croton oil, tartar emetic, etc. It is true that the greater number of these agents are

[1] De la Méthode Iatroliptice, Montpellier, An. xii.

only local in their operation, yet they owe their virtues either to their absorption, or to their penetration.

Medicines are also applied to the derm denuded of its cuticle. This is known as the *endermic method.* Although it had been employed experimentally upon animals by Orfila and Magendie, and although Bally. at St. Domingo, applied calomel to the denuded derm of the epigastrium in yellow fever, it was first proposed as a systematic plan of treatment by Lembert and Lesieur, at Paris, in 1824.[1] Various observers soon confirmed the statements originally made respecting the efficiency of the new method, among whom may be mentioned Martin, in France,[2] and Dr. Gerhard, of Philadelphia,[3] The following conclusions of Dr. G., based upon observations made in nearly two hundred cases, may be regarded as substantially correct.

"Medicines applied to various parts of the body externally, provided they be placed in direct contact with the vascular surface of the cutis, produce similar effects in doses but little larger than when they are made to act directly upon the gastric mucous membrane.

"All medicinal substances have a peculiar affinity for certain organs or tissues, which is entirely independent of their immediate action upon such parts.

"Violent irritants or escharotics rarely produce any general effect, although this sometimes occurs.

"All other articles of sufficient activity may be used, provided the cutis be not too highly inflamed; when the latter is the case, soothing applications are, in the first place, necessary, or no absorption will take place."

Dr. Gerhard found that sulphate of quinia, the salts of morphia, and other preparations of opium, belladonna, cicuta, stramonium, and digitalis; aloes and gamboge; squill, emetin, and oil of tobacco; mercury and iodine were readily absorbable in this way, and produced all their specific effects; but the action of rhubarb, jalap, elaterium, croton oil, extract of colocynth, and tartar emetic, was slight or imperceptible. Ahrensen[4] and many others have, in the main, confirmed these results.

Numerous circumstances render the endermic method a precious resource for the therapeutist. An inflamed or irritable state of the stomach or bowels sometimes makes it difficult or even impossible to employ these organs for the administration of medicines. Hemorrhoids may thus disable the rectum, or chronic ulceration or acute inflammation, the stomach. The last case is a familiar one in malarial fevers. A mechanical obstruction, temporary or permanent, spasmodic or material, may prevent swallowing, as in tetanus, spasm of the œsophagus, cancer of this tube, a tumor compressing it, or a foreign body impacted in it. Or the stomach, and also the rectum, may have lost their sensibility, as it is called, to the action of certain

[1] Archives Gén., v. 158. [2] Revue Méd., Sept. 1827.
[3] N. Am. Med. and Surg. Journ., ix. 392; x. 145 (1830).
[4] Lond. Med. Gaz., xxiv. 699.

medicines. Their power of absorption may be impaired or lost, and yet the susceptibility of the nervous system to narcotics applied endermically may be fully retained. In other cases the patient will not swallow a medicine on account of its offensive taste, or it must be given without his knowledge.

An illustration of the value of the method is furnished by the following example. Salgues reports four cases of constipation in which all medicines given by the mouth were vomited, and those administered by the rectum were unavailing. But the application of finely-powdered colocynth or aloes to the blistered skin, produced copious evacuations.[1]

As the part to which the medicinal substances are here applied is small in extent, and does not, like the stomach, secrete liquids capable of dissolving them, they should contain but little inert matter, and, indeed, if possible, be susceptible of complete absorption. On this account, the salts of the vegetable alkaloids are to be preferred, viz., of strychnia, morphia, conia, aconitia, atropia, quinia, etc. Next to these, in fitness, are the narcotic extracts. But powerful chemical irritants and substances which are insoluble in the secretions of the derm are unsuited to the purpose.

Liquids are not well adapted to epidermic application because they cannot be kept in contact with the part. If applied on compresses, too large a proportion of them is wasted. Oily and fatty substances are sometimes used as vehicles, but besides diluting the medicine unduly, they are a direct hindrance to its absorption in most cases. If not of too irritating a nature, the medicine should be applied in powder; but, in the opposite case, a very small quantity of mild ointment may be used, or what is still better, a neutral powder, such as starch, will serve to mitigate the severity of the application. However applied, the medicine should be immediately covered with a piece of soft rag or lint spread with simple ointment, or impermeable cloth.

The requisite vesication may be produced by various escharotics, by mineral acids, by an iron instrument dipped in boiling water, by caustic ammonia, or by cantharides. Of all these, the last is to be preferred, for it does not involve the cutis so deeply, nor leave a scar, as do the acids and the hot iron, nor is it so painful as ammonia. When the medicine is to be used in a concentrated form, a blister not more than an inch or two in diameter should be applied for two or three hours, after which, under a poultice or a dressing of simple ointment, the necessary vesication will be produced. It is better not to remove the cuticle at the first dressing, but to insert the medicine by raising an edge of the detached membrane. On each renewal of the dressing, the part should be cleansed with warm water, or soap and water.

It is difficult to determine precisely the relative doses of medicine to be used by the endermic method. Two or three times the

[1] Abeille Méd., ii. 30.

average dose by the mouth, is that which is generally prescribed on a first trial.

The epigastrium is the part most usually selected for the endermic application of medicines; but the arms or thighs may be used if more convenient, or in alternation with the part first mentioned. In painful disorders, a portion of the skin nearest the part affected is generally to be preferred.

Another method of introducing medicines through the skin, is *inoculation*. It was first suggested by Lafargue, in a memoir presented to the Parisian Academy of Medicine in 1836. He made use of morphia, strychina, belladonna, and quinia, and seemed to attach more importance to the form and dimensions of the pustules produced than to the action of the medicines upon the economy, which, indeed, according to a report of Martin Solon upon the paper of Lafargue, appears to have been very slight indeed.[1] In a later article, by the last-named writer, fifteen or twenty punctures are said to have been necessary to obtain the narcotic effect of morphia. He appears, however, to have been successful in relieving many local pains of a neuralgic and rheumatic character. Besides the substances above mentioned, he also inoculated veratria, tartar emetic, and croton oil.[2] But this method was subsequently rendered vastly more efficient by Dr. A. Wood,[3] and by Langenbeck, who showed that as the mechanism for cutaneous absorption lies *under* the cutis and not in it, the most marked effects were to be expected only when medicinal substances are introduced quite through the true skin.[4] Indeed, the effects of the *hypodermic* medication are incomparably greater. Often, says the last-named author, have I seen iodine employed after this manner produce a more decided effect than three times the quantity applied endermically. Medicines also exercise a more protracted influence than when used in any other manner. Four grains of the extract of hyoscyamus, for instance, inoculated in the skin of the temple produced headache, giddiness, redness of the face, dilatation of the pupils, transitory disturbance of the mind, burning in the throat and intense thirst, which continued for the space of three days.

The singular statement is made that the phenomena produced by the hypodermic use and inoculation of medicines, are in some cases different from those occasioned by their internal administration. Thus musk is powerfully anodyne, and croton oil does not produce diarrhœa. Hence it is probable that some medicines, taken internally, owe the peculiarity of their action to a decomposition in the primæ viæ, and others chiefly to a local operation, whereby their absorption is prevented or limited. So several animal poisons, which are active, and even fatal, when introduced into the blood, may be taken into the stomach with impunity, as, *e. g.*, the venom of serpents, the poison of rabies, etc.

[1] Bull. de l'Acad., i. 13, 40, 249. [2] Bull. de Thérap., xxxiii. 19, 182, 349.
[3] Edinb. Med. and Surg. Journ., April, 1855.
[4] Die Impfung der Arzneikörper. Hannover, 1856.

The degree of local irritation produced by inoculated medicines depends, in some degree, upon the susceptibility of the patient, and to the part to which they are applied. It is not always such as might be expected from the qualities of the substance used. Croton oil and tartar emetic are generally well borne, and for a few hours, at most, give rise to burning, smarting, or a sense of tension. In most cases they are less painful than sinapisms or blisters, a circumstance which may be explained by the consideration that the latter are applied to the sensitive and highly vascular chorion, but the former to the cellular tissue beneath the skin. If, however, the quantity of the medicine introduced be excessive, active local disturbance may ensue.

The phenomena produced by these operations, when irritating incipients are employed, are usually the following: the skin is more or less reddened according to the quantity of the medicine introduced. It swells, and grows more or less hard, according as its own and the subcutaneous tissue are more or less dense. The puncture remains open, and a small discharge of serum or pus may follow upon pressure. If several punctures are made too close together, they may ulcerate, and form a single opening, followed by an ulcer. In adults, a single puncture into which the medicated lancet has been several times thrust, may remain open for eight or ten days.

Medicines may be inoculated, as the matter is introduced in vaccination, by means of a small lancet with an elongated diamond shaped head, very sharp at the point and on the edges, and somewhat bent, as well as concave, upon one of its faces, for the purpose of holding the medicinal substance. The lance-head is connected by means of a round and narrow stem with a convenient handle, and is itself one or two lines in breadth, though sometimes, and for special operations, a breadth of four or five lines is required. The inoculation is performed by thrusting the instrument, charged with the medicine, obliquely through the skin, and pressing in the direction of the back of the instrument until the integument is entirely penetrated, so as to prevent a loss of the medicinal substance. On withdrawing it, however, pressure is to be made in the opposite direction, and a finger laid upon the skin in front of the lancet, so as to empty the latter completely. If the hemorrhage is considerable, it should be allowed to subside before inserting the needle anew. Medicinal substances may also be introduced beneath the skin upon a small piece of linen lint through an opening made with a lancet.

Hypodermic Medication.—Instead of the lancet described above, and which is now seldom used, a small syringe is employed by which the medicine is injected in a liquid state, after the manner recommended by Dr. Wood, Mr. Rynd, Dr. Hunter, M. Béhier, and others. The syringe is furnished with fine pointed tubes, of various sizes, which may be thrust through the skin while attached to the instrument. Sometimes the piston is so adjusted as to be advanced or withdrawn by means of a screw, on which a scale is marked denoting the quantity of the liquid which is expelled by every revolution of

the piston. This manœuvre, however, renders the operation tedious; and hence it has been found better that the piston should move as in ordinary syringes; but in order to measure accurately the quantity of liquid expelled, its rod should be graduated. To avoid errors and disappointment from the escape of a portion of the medicated liquid behind the piston, the cylinder of the syringe is made of glass; and, to prevent corrosion of its other parts, they should be heavily gilt.

The advantages of the hypodermic introduction of medicines into the system over the other methods described, consist chiefly in the rapidity, intensity, and certainty of action which it secures. A few minutes may suffice to produce sleep when morphia is employed in this manner, and the dose required is smaller and more uniform than when it is taken into the stomach, from which its absorption is dependent, among other things, upon the state of the nervous system, the presence or absence of food in the organ, the condition of its coats, its ability to retain the medicine, and the possibility of the digestion or decomposition of the latter in the gastric juices. It has been found that the minimum dose of atropia sufficient to produce death in rabbits, is, by the mouth, $\frac{1}{60}$ grain; by the rectum, $\frac{1}{50}$ grain; and by the skin, $\frac{1}{300}$ grain. These causes and other similar ones, which delay and modify the effect of a medicine so soluble and absorbable as morphia, are much more operative in the case of opium itself, of which it is well known that doses quite sufficient to destroy life are sometimes retained unaltered in the stomach for an indefinite period. It is also to be observed as a strong recommendation of the hypodermic method, that the functions of the stomach are less seriously interfered with than when the medicine is introduced into that organ; the loss of appetite, the nausea and vomiting, and the constipation which often constitute very serious inconveniences of the ordinary method of administering narcotics, are in a great measure obviated by the one under consideration. It is also claimed that its effects are more permanent, as well as more prompt, uncomplicated, and decided, a fact which is chiefly illustrated in the treatment of local disorders, and especially in that of persistent neuralgia of a particular nerve. Some observers, indeed, maintain that the local effects of appropriate medicines, and especially of narcotics, are equally manifest whether the medicine be introduced at a remote point or directly at the seat of pain. But this view does not seem to be admissible, since the anodyne and other effects of opium, belladonna, and other narcotics, are habitually obtained by means of lotions, liniments, plasters, and cataplasms, containing them, without any manifestation of a general influence upon the nervous system. The pupil of one eye may be dilated with belladonna, although its fellow remains unaffected, and the local benumbing influence of aconite upon the fingers is a familiar fact. On the other hand, these same agents, administered internally, do not become anodynes of local pain, without at the same time affecting the whole economy.

It has been objected to the hypodermic method, that medicines

of great power may be accidentally introduced into a vein, and, being thus rapidly carried to the nervous centres, occasion alarming or even fatal effects. Of the former, some cases have, perhaps, occurred, but of the latter we are unacquainted with any example. The possibility of such an accident suggests the propriety of injecting strong narcotic solutions slowly; and the further precaution of withdrawing the point of the canula somewhat before expelling the medicinal solution.

It may for convenience be stated in this place that the primary dose of a salt of morphia should never exceed one-eighth, of atropia one-sixtieth, of strychnia one twenty-fourth of a grain, and of quinia one or two grains. Other agents have been used more or less, but these are the only ones of capital importance. The following suggestions for the management of hypodermic injections are substantially those originally made by Dr. Hunter. A fold of skin being rendered tense by the finger and thumb of the left hand, and the canula held firmly, the point, being at right angles to the surface of the skin, is thrust through it with a quick and steady movement; after which the canula, depressed so as to lie underneath and parallel to the skin within the subcutaneous connective tissue, should be pushed forward to the distance of about an inch, and then slightly withdrawn so that its orifice shall be unobstructed. The required quantity of the solution having been injected, the canula is wholly withdrawn, while gentle pressure is made over the wound, to prevent the medicated fluid from escaping. When the object is to allay local pain, the injection should be made as near the seat of pain as possible, due regard being had to the safety of the adjacent organs; but when a general effect is desired, the operation may be performed on the outside of the arm, or on any convenient portion of the back. If a repetition of the operation becomes necessary, it may be made at the seat of the original puncture, unless this should be in an exposed part of the body, or unless the wound exhibits a tendency to suppurate. But in practice a fresh puncture is usually made at each operation. The pain which it causes is easily prevented by the use of atomized ether. Moistening the part with carbolic acid is said to have the same effect.

Inhalation.—From the time of Dioscorides and Galen, the inhalation of medicated vapors has been more or less employed in various diseases, and especially in those of the lungs. In the East the fumes of opium have been used from time immemorial, to produce intoxication. In 1580, Piso recommended hot dry air for the cure of consumption. In 1654, Bennet, a London physician, caused the patient to breathe the atmosphere of a chamber filled with fumes or vapors of various medicinal substances, including the gum resins. Bartolinus prescribed the vapors of pectoral and healing plants. Willis advised the fumes of various balsamic substances and of orpiment, and Mead the former of these medicines. In 1769, Buchoz employed the vapors of a decoction of several herbs, and about the same time Billard adopted the method of dry inha-

lation, after the manner of Bennet.[1] In later days we find that after the discovery of the elementary gases in the last century, this mode of treatment was revived, and Beddoes extolled it as a panacea for nearly all chronic ailments. Quite recently the action and uses of carbonic acid, oxygen, and nitrogen have been studied by Demarquay.[2] With the demonstration that medicines act chiefly by being absorbed, and that the lungs are very active in the absorption of gases and vapors, the idea naturally presented itself of making use of these organs for the purpose of applying medicines in their own diseases, as well as in those of the whole system. So Davy, in 1814, recommended nitrous oxide gas, and Crichton, in 1823, introduced anew the inhalation of the vapor of boiling tar, in pulmonary affections. For the same diseases the vapor of iodine was recommended by Sir James Murray and Sir C. Scudamore. The addition of a little tincture of conium was found beneficial in subduing the irritating qualities of the gas. In France and Germany chlorine gas was used somewhat later, as an inhalation for the cure of phthisis. Belladonna and stramonium were smoked for the relief of spasmodic asthma and various pulmonary complaints, as first recommended by Martin-Solon. Trousseau revived the ancient practice of inhaling arsenical vapors in chronic bronchial affections. Naphtha had been proposed by Crichton in 1816, in these diseases; the same remedy was vulgarized by Hastings, and tar vapors were held to be as sovereign a remedy as tar water had been half a century before. Skoda eulogized them in gangrene of the lung, and Raspail invented his camphorated cigars for the solace of innumerable ills. Harwood published, in 1839, an elaborate essay on the advantages of inhalation in pulmonary affections, in which he speaks of all the substances hitherto used for the purpose, and, among them, of sulphuric ether, of which he remarks that, "in inhalation, its sedative or anti-spasmodic influence appears liable to be overwhelmed by its stimulant properties."[3] The discovery of the anæsthetic effects of the inhalation of sulphuric ether in 1847, and soon after of the similar operation of chloroform, gave a new impulse to this branch of the healing art. The inhalation of iodic vapors was revived by Piorry and by Chartroule, and the two liquids just mentioned were employed as vehicles for conveying a great variety of substances into the system through the lungs. The vapors of ammonia and of sal ammoniac were declared by Giesler and Laségue, to effect very remarkable changes in phthisical cases.[4] In 1851, the late Dr. Snow proposed an apparatus for the inhalation of dry and moist vapors, so arranged as to insure their disengagement from the substance supplying them and their complete reception by the patient.[5] A somewhat similar but more elegant apparatus was more recently employed by Mandl,

Kneeland, Boston Med. and Surg. Journ., lviii. 49.

Essai de Pneumatologie Médicale. Paris, 1866.

[3] On the Practical Use of Inhalations, in Diseases of the Throat and Chest. Lond., 1839.

[4] Archives Gén., 5ème sér., vii. 721.

[5] Lond. Journ. of Med., iii. 122.

who says, very correctly, that of all the methods of treating that rebellious form of chronic bronchitis which follows chronic pleurisy, this is the most successful.[1] Except for the purpose of allaying cough, applying stimulants to the fauces and the bronchial mucous membrane, and introducing anæsthetic vapors as rapidly as possible into the system, this method is seldom employed. As the above restrospect of its history shows, it has by turns been vaunted and neglected, and after having been chiefly employed by practitioners who inhabit the debatable region between medicine and quackery, it has, as will appear below, become a permanent element in legitimate therapeutics.[2]

Mr. Charles Matthews proposed anew the inhalation of the fumes of burning medicinal substances by a method which is thus described.[3] "First, we form a slender tube of thin paper, of suitable length, in one end of which is fixed a short and stiff tube of the same material, to serve as a handle and mouthpiece. Secondly, is constructed another tube, of delicate tissue paper, closed at the bottom, to hold the powder to be smoked, and fitting in the first tube in such a way, that there will remain just space enough between the two for the passage of the smoke. The inner tube being then filled with the powder, and twisted to a point, the compound tube is ready to be lighted and smoked in the manner of a cigar." The powder of cubebs is recommended as the most suitable excipient for the more active medicinal powders; but that of decayed wood, pine bark, etc., is also mentioned.

Another mode of inhaling medicinal substances was recommended by Prof. Max. Langenbeck.[4] He proposed a hollow, flattened globe, made of box-wood or ivory, and varying in diameter from three-quarters of an inch, to one and a half inch. It was composed of two halves screwed together, and pierced on either face with from six to nine apertures, through which the inspired air passed. The interior was filled with the medicated substance. The instrument was either placed upon the tongue between the rows of molar teeth, and was thus totally inclosed in the cavity of the mouth, or the anterior part of it was taken between the lips, in such a manner as to be nearly concealed. Only such substances were used as would enter the lungs without irritating them. Cotton wool or charpie soaked with liquid or oily medicines, or a little bag holding the solid matters, such as herbs, extracts, resins, etc., was placed in the respirator. It is unnecessary to enumerate the articles employed by Dr. Langenbeck, or the various diseases which they are claimed to palliate or cure. We will only remark that his inhaler does not appear to present any advantages over the simpler ones applied upon the outside of the mouth.

The next form which this method assumed was quite a novel

[1] Bull. de Thérap., liii. 433.

[2] In the articles on Oxygen, Ether, Chloroform, etc., additional particulars respecting inhalation will be found.

[3] Amer. Med. Times, Nov. 1860, p. 365.

[4] Deutsche Klinik, March, 1861, p. 129; also Times and Gaz., April, 1861, p. 429.

one. M. Sales-Girons conceived the idea of causing the patient to breathe an atmosphere saturated with water at the ordinary temperature and impregnated with various medicinal substances, either artificially or as natural mineral waters. To accomplish the former object the water was projected with great force from numerous capillary apertures against the surface of slightly convex disks, by which means it was broken or "pulverized" into a fine mist, such as rises from the rocks against which a waterfall strikes, except that its particles were much more minute.[1] Although much of the time of the Parisian Academy of Medicine was consumed in debating the principles and pretensions of this ingenious invention, the only practical results of the discussion appear to have been to show, first, that vapors can enter the lungs, and, secondly, that although the fixed principles of mineral waters are not contained in vapors generated by heat, they do exist in those produced by pulverization. Its practical application is probably restricted to bathing establishments at mineral springs and in certain special hospitals in European capitals. Modifications of the apparatus just described have been proposed by Dr. Waldenberg,[2] Mathieu, Mayer, and others.

All of these contrivances, most of which were clumsy, costly, and liable to get out of repair, have been superseded by a popular toy used at first to diffuse scented liquids through the air. This consists essentially of two glass tubes, each of them being about a sixth of an inch in diameter, and drawn to a point at one end in which there is a capillary orifice. When they are so placed that the axes of the two capillary orifices are at right angles with one another and yet in close juxtaposition, it is evident that if a strong current of air or liquid or vapor is forced through the one, it will tend to exhaust the air from the other tube. If now the larger extremity of the latter tube is introduced into a liquid while it is being exhausted of air in the manner described, the liquid must rise within and fill it, and finally escape by the capillary opening, where it will immediately be dispersed in the form of vapor by the force of the impinging current of air. The liquid thus raised and projected may consist of any vaporizable medicinal solution, and the force which converts it into vapor may be air alone or steam. For creating the former a caoutchouc ball with a valve and a conducting tube is employed, and a steady and continuous current of air is maintained by interposing in the course of the tube an elastic air chamber. In the steam atomizer a small boiler heated by a spirit lamp generates a current of steam which, as it issues from the orifice of a horizontal glass tube, exhausts a vertical tube, as in the instrument already described, and mingles the steam and the medicated fluid at the point of apposition of the two glass tubes, throwing a continuous stream of vapor upon the affected part. As the only essential element of this apparatus is the confluence of the two streams, with a certain force, at right angles to one another, it

[1] Bull. de Thér., liv. 385; Bull. de l'Acad. de Méd., xxi., xxv., xxvi., xxvii., and xxxii.

[2] Prager Vierteljahr., lxxv. 78.

is evident that the tubes themselves which convey the streams may be long or short, straight or curved, and parallel to, or at any angle with, one another. Hence, in practice they are but an inch or two in length when the medicated vapor is to be propelled against the surface of the body, and from four to six inches long when deep-seated parts, as the larynx and posterior nares, are to be treated. They may also be made of different materials; glass or vulcanite being generally preferred for medicinal, and silver for surgical, purposes. The latter substance is less suitable than glass for the transmission of corrosive liquids, and of those which form a deposit which may require the application of an acid for its removal. As the active ingredient of the atomized fluid is sometimes irritant, or as in the case of nitrate of silver may discolor the skin, the face ought to be protected from contact with it, by receiving the vapor into the mouth, nostril, or upon any other part through a glass funnel of large aperture. More temporary, but equally efficient, expedients will readily suggest themselves to an ingenious operator.

Whatever advantages have been claimed for the topical treatment of the nasal passages, the pharynx, the larynx, and the air tubes, by means of medicated solutions applied with a brush or a sponge, are vastly exceeded by those afforded by the inhalation of medicated vapors. For not only is the number of agents employed by the latter method far greater and more various in kind, but they reach portions of the mucous membrane which the former cannot touch, and by the duration, steadiness, and gentleness of their action exert, in by far the greater number of cases, a more salutary influence. Indeed, it is difficult to estimate too highly the value of atomized liquid medicines in the class of diseases referred to, whether as superior to other topical medications, or as a frequent substitute for remedies administered by the stomach which too often, even when they succeed in allaying the pulmonary symptoms, tend to derange the digestive function, and therefore to retard and embarrass the cure.

It is unnecessary to enumerate all of the affections of the throat and respiratory organs for whose cure this method is the most appropriate, for they include all lesions of secretion, mucous, purulent, or serous, all superficial alterations of structure, all lesions of irritability (spasms), and even tissue changes tending to fatal destruction, and the hemorrhage arising from these, as well as from congestive derangements. Rhinitis, pharyngitis, laryngitis (including catarrhal and pseudo-membranous croup and œdema of the glottis), and bronchitis, in all their forms, are more or less amenable to its power, and it is also a most valuable palliative in organic (especially phthisical) diseases of the lungs, by modifying or even removing the complications which aggravate their violence, and hasten their fatal termination. Among these hæmoptisis is one of the most important. Whooping-cough, aphonia, and purely nervous as well as emphysematous asthma are favorably influenced by appropriate inhalations.

The mode of action of this method depends not only upon the

particular medicine employed, which is, indeed, the essential condition, but also in some good degree upon the soothing influence of the watery vapor in which they are suspended. Its temperature is, also, of some importance, and although this can never be elevated, owing to the quantity of caloric rendered latent by the generation of the vapor employed, it may be modified by heating the liquid which is to be vaporized. For this purpose the atomizers in common use have a small spirit lamp attached to their side.

It is important that the patient, who for the first time employs this treatment, should inhale only the vapor of water or of a feebly medicated solution, in order that he may learn how to breathe quickly or slowly, deeply or shortly, according to the situation of the affected part, and that he may not become alarmed or discouraged by the irritation which would be produced by a contrary procedure. Nor should his first trial be prolonged. From three to five minutes will suffice at the beginning; but as habit imparts confidence and diminishes the irritability of the respiratory passages, each sitting may be lengthened to ten or even fifteen minutes. It is not generally advisable to close the nostrils during the inhalation, but in some cases of bronchial disease it is to be advised.

The strength of the solutions employed must necessarily vary with all the conditions which modify the doses of medicines. The following may be taken as representing ordinary usage at present. Nitrate of silver, from ½ gr. to 10 grs. to a fluidounce of water; tincture of chloride of iron, 1 to 10♏; solution of perchloride of iron, 1 to 5♏; bichloride of mercury, ¼ gr. to 2 grs.; acetate of lead, 1 to 10 grs.; sulphate of zinc, 1 to 10 grs.; common salt, 1 to 20 grs.; bromide of potassium, 2 to 10 grs.; solution of arsenite of potassa, 1 to 5♏; tannic acid, 1 to 10 grs.; alum, 2 to 20 grs.; muriate of ammonia, 5 to 15 grs.; compound solution of iodine, 2 to 10♏; oil of turpentine, 1 to 2♏; tincture of opium, 5 to 20♏; acetate of morphia, $\frac{1}{32}$ gr. to ½ gr.; fluid extract of hyoscyamus, 5 to 20♏; fluid extract of conium, 5 to 20♏; extract of cannabis, ⅓ gr. to 2 grs.[1]

Liquid substances have also been introduced into the air passages by means of a sponge or a syringe. Originally proposed and practised by MM. Trousseau and Belloc, and Sir Charles Bell, this method has since been applied in a great variety of cases, and with numerous medicines, by Dr. Green, of New York, and by E. Watson, S. S. Alison, DeMussy, and others in Europe. Its utility is chiefly displayed in the treatment of chronic inflammations of the larynx. Guinier has shown that, by a proper method of gargling, liquids will reach the superior or false vocal cords. The head should not be strongly extended, as is commonly done, nor a gurgling sound produced, nor should breathing be possible during the operation. On the contrary, the head should be but slightly raised, the mouth not too widely opened, the lower jaw advanced, and the vowel sound *a* uttered.[2]

[1] Many other solutions are employed. See "Inhalation, by J. Solis Cohen, M.D., Philadelphia, 1867."

[2] Bull. de Thér., lxix. 139.

The skin and mucous membrane serving as integuments to the organs of several of the senses, the *eyes*, *ears*, and *nose*, are also used for the application of medicines which are designed to exert a local action chiefly, though occasionally, as when certain irritants (sternutatories) are applied to the nasal passages, a derivative operation from the head or eyes is intended. Medical substances are also introduced into the *vagina*, but generally to relieve pain or modify the action of its lining membrane or the condition of the uterus. A similar remark applies to the *urethra* and the *bladder*.

The application of medicines to the *nasal passages* has become as common as it is an efficient means of cleansing these cavities of irritating and fetid contents, and promoting the restoration of their lining membrane to its normal condition. Weber, of Leipsic, was the first to observe that when a stream of water is passed into one nostril it will run out at the other, provided that the patient breathe through the mouth meanwhile. Dr. Thudicum first applied this peculiar fact to the treatment of *ozæna* in 1864, and since that time his instrument, or Mr. Heath's modification of it, has come into general use. The former consists of a glass bottle, holding a pint or more, near the bottom of which is an aperture to which is attached a small India-rubber tube three or four feet in length. The further end of the tube is provided with a collar. This end being introduced into one nostril, the vessel containing the liquid to be injected is gradually raised until its contents are about to flow into the nostril. The patient then breathes through his open mouth, by which act the soft palate is thrown horizontally across the upper part of the pharynx, entirely occluding it, and forcing the liquid that enters by its own weight to escape by the other nostril, carrying with it the obstructions. By reversing the current both nostrils and all their anfractuosities may be effectually cleansed or medicated. Mr. Heath has further simplified the instrument by attaching one end of the tubing to a perforated leaden weight which can be placed in a common jug. Enough of the tubing to extend, at the least, to a little more than twice the height of the vessel, is immersed in the liquid, and at that distance from the weight having been pinched between the finger and thumb, and carried over the side of the vessel, it forms a siphon through which the fluid then freely flows. In all cases the force and quantity of the liquid should be slight at first and until the patient grows familiar with the operation. The liquid should always be tepid, to prevent the smarting caused by cold water, which may also be mitigated by the addition of a small quantity of common salt. It should also be weaker at first than may afterwards be necessary.

That caution is necessary in employing the nasal douche is shown by its occasioning inflammation of the internal ear, with great suffering, in certain cases in which, either from obstruction of one of the nostrils, or from allowing the liquid to flow with too great force into them, the Eustachian tubes and the middle ear have been

invaded.[1] Such results may probably be avoided by the patient's carefully observing the rules for the use of the instrument.

From the account which has now been given, it will appear evident that every portion of the body in which organic changes are going on, is susceptible of absorbing medicinal substances, but that the gastro-intestinal mucous membrane is that which, on the whole, is most convenient in practice, and through which the most certain effects may be obtained. Next to this, the denuded derm and subcutaneous cellular tissue present the greatest advantages, after which, in order of importance, are the pulmonary mucous membrane and the veins. It is also evident that in many cases the local operation of medicines may be associated with that due to their absorption, or quite exceed the latter.

The Changes which Medicines undergo after Absorption.—It has been stated that the greater number of medicines undergo changes in the stomach and bowels, affecting their solubility and the facility of their absorption, and that these changes depend upon their chemical reaction with the pepsin or the acids of the stomach, or with the alkaline secretions of the pancreas and the liver. The changes in question may be, according to Mr. Headland, *combination*, *reconstruction*, or *decomposition*. When acids or alkalies are taken, they are neutralized soon after absorption, and converted into salts. This, as Mr. H. remarks, does not destroy their influence: for, in being neutralized they diminish, in the blood and in the system generally, the quantity of basic or of acid matter, and thus tend to alter the reaction of the secretions. Although an acid may combine in the blood with soda, or with salts of soda, yet by so doing it creates an excess of some other, and probably an animal acid, which, being set free, acts on the secretion of urine much in the same way that the first acid would have done. But it is maintained that when salts, oxides, etc., are taken into the blood, they do not really yield to surrounding chemical affinities, as they do out of the body. Did they do so, many of our most valuable medicines would be decomposed and rendered insoluble there. All the mineral salts would be precipitated by the free soda in the fluid. Acetate of lead would be immediately decomposed by the sulphates, and nitrate of silver precipitated by the chlorides. It is probable that the vital forces, as well as the viscidity of the plasma, exert a retarding or controlling power over such chemical tendencies. Some substances are decomposed while passing out of the body. Thus the contents of the intestines cause the formation of sulphuret of iron, when chalybeates are taken, which blackens the feces: and the saliva forms a sulphuret of lead along the edge of the gums, when lead is administered for some time. So Bernard found that when a solution of prussiate of potassa and one of lactate of iron were injected simultaneously into the opposite jugular veins of a rabbit, the urine of the animal was rendered deeply blue, while no

[1] Comp. Pardee, N. York Med. Record, iv. 530; Harlan, Phila. Med. Times, i. 396.

trace of a similar color existed in any of the organs.[1] On the other hand, certain substances introduced separately into the blood may there unite and produce effects of which neither by itself is capable. This, as Bernard has shown, is the case with amygdalin and emulsin. By their union in water, prussic acid is generated, and hence, if injected separately into the blood, the peculiar effects of this poison are developed. The same result takes place if amygdalin is introduced into the digestive tube, and the emulsin into the blood; but not if the counter-experiment is tried, for in the former case the amygdalin is absorbed, but in the latter the emulsin does not undergo absorption.[2]

In other cases the elements of the substance employed are *reconstructed.* Thus, when tannic acid is administered, gallic acid is secreted with the urine. Benzoic and cinnamic acids are converted into hippuric acid, which also passes out with the urine. Turpentine changes into a volatile oil, which communicates to the urine an odor of violets.

Again, the medicinal substance may be *decomposed*, and under a new arrangement of its elements, its action may be neutralized or reversed. The alkaline bases of vegetable salts, for example, are changed in the blood into alkaline carbonates, and affect the urine in the same way as free alkalies.

In the existing state of knowledge concerning these relations of medicines to the economy, it would be unwise to adopt them implicitly as guides in practice. At the same time they should not be overlooked when they serve to explain results which have been reached empirically. Natural science can advance only when she is supported on either side by observation and experiment: without them she either sinks helpless or wanders at random through the void, exposed to perish by mere inanition or by the shock of some bright erratic semblance of a star. Her proper pathway is upon the earth and through material phenomena. Too often elated by their glories, she throws herself into the air on the wings of abstract speculation, but never fails to fall discomfited, and less able than before to pursue the toilsome road that leads to truth.

Of the Curative Action of Medicines.

Having now considered the manner in which medicines, as material agents, operate upon the animal economy, and particularly the mechanism by which they enter the system and are conveyed from place to place, and also some of the changes which they work in the fluids, we may briefly inquire respecting the mode in which they exercise their *curative* action, or by what modifications of substance or function they effect this object.

The operation of a medicine depends upon numerous circumstances. First, and evidently, it depends upon its own inherent and essential qualities. Opium soothes pain, and croton oil purges, and ipecacuanha vomits, because it is their nature so to do. Further,

[1] Archives Gén., 4ème sèr., xvi. 63. [2] Lond. Med. Gaz., Nov. 1850, p. 908.

the degree of this operation depends upon the dose of the medicine administered, and is, within certain limits, proportioned to it. The solid or liquid state of the medicine, the condition of the organ, or of the person on which it acts, etc., will still further modify its action. In almost every case, medicines produce, either upon the part to which they are applied, or upon the system generally, an impression which is called their *action*. This is either *essential* or *contingent*. The former is that which the medicine exerts under ordinary circumstances, as an astringent, demulcent, emetic, purgative, or tonic. The latter depends upon the conditions of the individual case, as when an emetic also acts as a purgative or a diaphoretic, or when copaiba, besides modifying the urine, occasions an eruption of urticaria. In another sense, the removal of diseases may be called a contingent effect of medicines, but generally this is a remote consequence of their essential action, and is called their *therapeutic operation*. When medicines are administered to the sick, it is difficult, and often impossible, to distinguish between certain effects produced directly by the remedy, and those which result from the spontaneous course of the disease. Thus, during a fever, if diaphoresis occurs upon the decline of the paroxysm, we are apt to attribute directly to the remedy employed what was really due to the natural crisis of the attack. This distinction is nevertheless important; as, for example, when opening of the bowels follows the administration of opium in colica pictonum. The nature of opium is to constipate, and, in this case, it only operates otherwise by inducing relaxation of the contracted muscular coat of the bowels. This example shows that the physiological action may become subordinated to the therapeutical action of a medicine, or, if it be preferred, that a relatively stronger therapeutical action (the antispasmodic) may in this case outweigh the weaker (the constipating). In many cures, however, there is no evident distinction between the two operations, either because the medicine is administered in such doses as do not disturb the physiological action of the system, or because, by the very nature of the medicine itself, it cures the disease without deranging the functions. Mercury, as an antiphlogistic and as an anti-syphilitic remedy, illustrates both of these conditions.

There is also a *primary* and a *secondary* operation of medicines. Sometimes the one and sometimes the other is curative. All medicinal stimulants are useful by their primary operation alone, and, indeed, the depression which ensues tends to impair the advantages of the original impression. Primary sedatives seldom exert a secondary stimulant operation; indeed, cold is the only one that has this effect, and only when it is applied in a certain degree. The terms in question are, however, frequently used to indicate a difference in the kind as well as in the degree of action. Vegetable tonics, for example, act as stimulants to the stomach, and this is their primary action; but as a consequence of it, the function of digestion is more thoroughly performed, and the nutrition of the body is improved. The latter constitutes their secondary operation.

Purgatives and emetics irritate the bowels and occasion diarrhœa or vomiting; this is their primary operation, but they may at the same time relieve congestion of the brain or lungs, and thus exert a secondary and curative influence. In these cases the secondary operation is also called *indirect*, as opposed to the *direct*, which might here be substituted for the former, by means of cups, leeches, or blisters, applied to the head or chest. The sympathetic relations established between two organs which are not anatomically connected, except through the nervous and vascular systems, enable us, in many cases, to make use of an indirect medication. Thus, suction of the mamma will sometimes induce a premature action of the gravid uterus; in metastasis of the mumps from the parotid gland to the testis, warm or stimulant applications will often recall the affection to its original seat. Similar illustrations abound in the history of gout and rheumatism.

The *specific* operation of medicines requires more particular examination. By a specific medicine, says Boyle, "I do not understand one that will cure a disease infallibly and universally; for, I confess, I never yet met with any such remedy. Nor do I, by a specific medicine, mean one that, like a charm, works only by some latent and unaccountable property, without the assistance of a known quality. But by specific, I here denote a medicine that most commonly, and better than ordinary means, gives considerable relief to the patient by acting principally upon the account of some peculiar virtue; so that if it have any benign manifest quality, yet the service it does is greater than can reasonably be ascribed to such a degree of the manifest quality it possesses."[1] Modern investigations have not discovered that sort of specific which Boyle never met with, but there are several which do exert a curative virtue "without the assistance of a known quality" to explain their cures. These are mercury, cinchona, iodine, and colchicum, which in syphilis, ague, goitre, and gout, respectively, are capable of curing without the intervention of any evident modification either of function or of structure. But as these effects are not absolute, as there are many cases of every disease mentioned which are rebellious to the corresponding remedy, we are forced to suspect that even these medicines are not specifics in the sense of Boyle's second definition. At the same time, as we are wholly and absolutely ignorant of their mode of cure, and almost or quite as ignorant of the nature of the diseases to which they are antidotes, it is not impossible that in the progress of discovery the now unknown elements may be disclosed, and that we shall find these medicines illustrating some of the laws under which remedies in general operate. The third definition of Boyle is one which cannot be accepted unless it be in a popular rather than a scientific sense. To say that opium is a specific for bilious colic, or cholera morbus, or that alcohol is a specific for delirium tremens, merely signifies that, generally, these medicines are curative of the diseases named, but by no means so

[1] Works, by SHAW, iii. 546.

constantly as in the case of the true specifies, and also that they cure by virtue of properties which they manifest under all circumstances in which they are employed. They fall under a general therapeutic law; whereas the curative operation of every one of the four specifics mentioned has no evident relation to the effects which it produces upon healthy structure or function.

The investigations which of late years have taken place concerning the operation of medicines have led to an explanation of the ancient doctrine that certain of them especially affect particular organs. The peculiarity has been called their *elective action.* Some medicines tend to escape from the body through certain organs rather than through others, and in doing so, to exert a stimulant influence upon them, or in addition, as in the case of certain glands, to modify their secretion. So the alkalies, and ammonia in particular, act upon the mucous membranes, and, in the case of the bronchia, dissolve or dilute the tenacious mucus which clogs them, and facilitate expectoration. Turpentine is excreted by the liver, and being a solvent of the bile, tends to render its discharge more free. It is even supposed to be capable of dissolving biliary concretions. Digitalis and squill augment the urinary secretion by the addition of a large proportion of water. Mercury occasions an excessive flow of saliva. Or, to take examples from among the non-secreting organs, opium and alcohol affect the brain; iodine occasions atrophy of certain parts, viz., the mamma, the testis, the thyroid body, etc.; and ergot of rye acts upon the uterus.

In death from arsenic, more of that mineral has been found in the pancreas than in the kidney, and more in the lungs than in the liver. In poisoning by antimony, Dr. Nevins found it in the liver before it could be recognized in the kidneys, and in these before it could be detected in the bones; and after the use of the drug had been long suspended, he traced it in the bones, and not in the kidneys; and in these but not in the liver.[1]

The experiments of Bergeron and Lemattre on the elimination of medicinal substances from the skin during a hot air bath, show that the arsenites and arseniates of potassa and soda are eliminated without change; the arseniate of iron is decomposed, the iron is excreted with the urine, and the arsenic in the perspiration as an alkaline arseniate; protiodide of mercury is eliminated as a bichloride, traces of mercury may be detected in the sweat, and iodine appears in the saliva as an alkaline iodide; bichloride of mercury passes unchanged into the perspiration, and some traces of it can be found in the urine; finally, iodide of potassium cannot be detected in the cutaneous secretion, but it promptly appears in the urine and the saliva.[2]

M. Coze, of Strasburg, has drawn the following conclusions from his experiments: 1st. That volatile substances introduced into the system, have a tendency to be eliminated by those organs which in a physiological state secrete gases or vapors, the lungs and skin, for

[1] Liverpool Med.-Chir. Journ., i. 223. [2] Archives Gén., August, 1864, p. 173.

example. 2. That substances which contain principles the same as those which naturally form part of a secretion, are eliminated by the organs which furnish this secretion. 3. That substances which enter into the composition of an organ, when given as medicines, are carried to that organ. 4. That among the substances which do not naturally enter into the composition of the solids or fluids of the animal system, there are some whose actions obey what may be called their general chemical character; thus acid substances are eliminated with acid secretions.[1]

The following is a detailed statement of the several organs and the medicines which manifest an elective affinity for them.[2]

The activity and nutrition of the *brain* are stimulated by all essential oils and the plants containing them, as valerian, the gum resins, many aromatics, also ammonia and musk. Alcohol and camphor, which in small doses have this effect, impair the energy of the brain when largely administered, and so do opium, prussic acid, nicotia, hyoscyamia, and conia.

On the *nerves of the eyes*, opium and pulsatilla act as stimulants, belladonna and hyoscyamus as debilitants. The latter narcotics and stramonium dilate the pupil. Lachrymation is occasioned by onion, garlic, squill, and mustard.

The *spinal marrow* is excited by strychnia and all substances which yield it; quinia, tannin, and their salts, with theine and caffeine, act upon this organ also, the two former by diminishing and depressing its activity.

The *pharynx and œsophagus* are made to contract spasmodically by belladonna. (?)

The *stomach* is incited to vomiting by antimonial preparations, sulphate of zinc, ipecacuanha, etc. That tartar emetic at least has a specific action on the stomach is proved by its operating as an emetic, however introduced into the alimentary canal, and even when injected into the veins.

Purgatives have not perhaps so specific an action upon the *intestines* as emetics have upon the stomach, but, as we have seen, aloes and gamboge, when applied endermically, purge. In general, however, their operation seems to depend upon their being irritants. But some are supposed to act upon special portions of the intestinal canal. Mercurials affect the upper division of the bowel, and aloes and colocynth the large intestines more particularly.

Of medicines that act upon the *liver*, mercury is regarded the chief. In experiments upon animals, as it is elsewhere stated, the secretion of bile is alleged to be augmented by the administration of mercury, and this substance has afterwards been found in the hepatic duct. But this generally accepted opinion has been strongly controverted, as will be shown in its proper place. It must be remembered that mercury augments all the secretions by rendering the blood thinner; so that whatever influence it exerts upon the

[1] Am. Journ. of Med. Sci., April, 1843, p. 438.
[2] Albers, Allgemeine Arzneim., p. 149.

liver is shared by the other glands. Oil of turpentine renders the bile thinner and more abundant; coffee, on the contrary, makes it thicker and darker; alcohol increases its fatty constituents and those of the liver. Sulphates and tartrates are said to be cholagogues, and so is aloes; but although the experiments of Jörg appear to favor this view of the action of aloetic purgatives, it is not generally adopted; the coloring matter of the drug, it is thought, has been mistaken for that of the bile.

Iron, cinchona, and mercury are said to act upon the *spleen*, but their action is only indirect. The spleen is essential to a proper elaboration of the blood, and hence, after protracted malarious disease, anæmia coexists with enlargement of the spleen. The two first named remedies promote the contraction of this organ by improving the constitution of the blood, either directly or through the increased activity of the digestive function. When the increased size of the spleen results from inflammation, mercury may remove the fibrinous deposit and promote the reduction of the organ. Iodine has the same effect. But in neither case can this operation be regarded as specific.

Iodine, bromine, and carbonate of potassa are said to have a special influence upon the *thyroid gland*. When goitre is a simple glandular hypertrophy, and is unaccompanied by calcareous, scirrhous, or medullary transformation, or even an aneurismal condition, these remedies, but the first two especially, appear to have a specific power to cure.

The *salivary glands* are particularly influenced by the acrid narcotics, tobacco, belladonna, and conium, and by mercury and iodine. All of these, except the last, appear to act as irritants of the glands; but the salivation produced by iodine ceases when the medicine is suspended.

The *mammary gland* in the female is acted upon by bromine, iodine, carbonate of potassa, and mercury. Under their use the fat attached to the gland is removed, as well as the glandular substance itself, and consequently during lactation they diminish the secretion of milk. This latter is increased by fennel, anis, castor oil, and chervil (*Anthriscus cerefolium*), and diminished by belladonna, conium, iodine, sage, and hyssop. Its qualities are altered by wormwood.

Conium and mercury are said to affect the *pancreatic* secretion.

Many substances directly or indirectly increase the secretion of the *kidneys*, *e. g.*, digitalis, colchicum, squill, the combinations of potassa with vegetable acids and with nitric acid. Aconite and colchicum increase the discharge of urates; copaiva, cubebs, and black pepper augment its animal constituents; and the secretion is increased and variously modified by turpentine, copaiva, cubebs, juniper, senega, uva ursi, cantharides, cochineal, the salts of potassa above mentioned and other salts.

On the *urinary bladder* itself lime acts by diminishing its secretion, while the alkalies, and carbonate of potassa especially, increase it, as do also assafœtida, galbanum, petroleum, naphtha, and the empy-

reumatic oils. The ice plant (*Mesembryanthemum crystallinum*) is said to impair the nutrition of the walls of the organ; and camphor and oily substances to diminish its contractility and excitability.

Iodide of potassium is reputed to produce atrophy of the *ovaries*, while iron and vanilla augment their activity. Savin may excite ovaritis.

Cinnamon and borax, the root of the cotton plant, and ergot are held to be excitants of the gravid *uterus;* and borax, savin, myrrh, aloes, and iron tend to increase its congestion. Birdlime (*Viscum album*), when given continuously, is said to be a more active uterine stimulant than ergot, and, like it, to diminish uterine leucorrhœa and menorrhagia. It has been held to be the most certain of all remedies for these accidents of the menopause.

As special excitants of the *testes*, vanilla and spiced wines may be mentioned; but lupulin, camphor, and nitre reduce the action of these glands, and conium, iodine, and mercury may induce their atrophy.

The secretion of the *bronchia*, and the shedding and reproduction of their epithelium, are promoted by ammonia and its preparations, especially the muriate; by tartar emetic and other preparations of antimony; by substances furnishing a sweet extractive, such as liquorice; also by anis, fennel, copaiva, cubebs, and the essential and empyreumatic oils. The following are said first to increase, but by continued use to diminish, the bronchial secretion; benzoic and succinic acids, fennel, seneka, birdlime, horehound, and veronica (*Speedwell*).

The *urinary passages* are specially stimulated by cantharides, which may provoke erections and strangury. Pepper acts also upon these parts as a stimulant, and the same is true of copaiba, cubebs, Peruvian balsam, phosphorus, turpentine, etc. Camphor allays excitement of the urinary organs.

Sedatives of the *heart* and *bloodvessels* include white and green hellebore, aconite, colchicum, and squill; the principal stimulants of the same organs are alcohol, wine, iron, digitalis, and assafœtida.

Albers enumerates as special stimulants of the *skin*, elder flowers, linden blossoms, and solution of acetate of ammonia; as stimulating, while they excite it to healthy action, sulphur, antimony, dulcamara, guaiacum, benzoin, and empyreumatic oils; as diminishing the tendency to form fat, guaiacum, benzoin, and cantharides; as augmenting the deposit of fat, all oily and saponaceous substances; and as diminishing the sensibility of the skin, opium and conium, to which may be added ether, chloroform, aconite, etc.

The *muscles* have their excitability increased by strychnia, tea, and coffee; the opposite effect is produced by conia and nicotia.

In diseases of the *bones* attended with a deficiency of animal substance in them, as in rachitis, oil and fat become specific remedies; mollities ossium, on the other hand, is successfully treated with calcareous preparations. Albers states that phosphoric acid, which in old and in recent publications is alleged to have a specific operation upon scrofulous and rachitic affections of the bones, he has found, by repeated trials, to be wholly destitute of such a virtue.

Mercury and iodine have a peculiar influence upon diseases of the *absorbent* system, the former, however, chiefly in acute inflammatory disorders, and the latter in chronic affections, and both especially when a considerable deposit of organized or organizable effusion exists.

Affections of the *fibrous* tissue, as rheumatism and gout, appear to be peculiarly under the influence of aconite, guaiacum, cantharides, and iodide of potassium.

As the *blood* forms the channel through which many diseases are diffused, and as indeed they often directly depend upon its composition, it would be desirable to know what medicines modify its condition, and in what manner they do so. Of substances which are ranked as medicines, iron is the only one which directly augments the solid constituents of this fluid, all others, including saccharine and oleaginous medicines, are first either metamorphosed and vitalized by digestion, or else operate chiefly by promoting this process or that of nutrition. The influence of purely medicinal substances upon the composition of the blood is thus stated by Albers. Cinchona and the balsamic resins increase the red globules; cinchona and the bitter vegetable tonics and astringents augment the fibrin; oleaginous substances increase the fat; and salines, being absorbed into the blood, impede the absorption of oxygen, and hence, as Schultz maintains, prevent combustion of the tissues, and consequently operate as antiphlogistics. According to the first-named authority, the blood-globules are diminished by bloodletting, water, iodine, and the acids; the fibrin by mercury, iodine, and the alkalies; and the fat by carbonate of potassa, iodide of potassium, and mercury.

Of the above statements it is probable that many are premature, if not unfounded. They have been reproduced here as an illustration of the tendency of modern inquiry rather than as an epitome of established or even of accepted truths. It is to be hoped, however, that future investigations will throw light upon this most obscure department of experimental physiology, which must hereafter furnish the securest basis for a science of therapeutics, if such a science is possible.

Influences Modifying the Effects of Medicines.

In estimating the effects of a medicine, it is evident that much will depend upon its condition, and much, also, on that of the patient. In fact, it seems as if the fluctuating values of these two elements must necessarily and forever prevent the problems of therapeutics from being solved categorically. But this very circumstance renders it peculiarly important that we should learn as accurately as possible the value of all those influences which modify the results produced by the reactions of medicines within the economy, and thus diminish the chances of error in the treatment of disease. Such knowledge would always be difficult of attainment, even were medicines administered in their simplest forms and singly; but it

oftener happens that combinations are prescribed, into which not only two, but many, ingredients enter. These are often altered by mutual chemical reactions, so as to produce new compounds, possessing different qualities from either of the original constituents; or, when this is not the case, the resulting effect is determined by the sum of the several substances employed, and is consequently complex, and can seldom with certainty be anticipated. It may be useful to describe more particularly these sources of error, which, being known, form so many motives to circumspection in practice.

Diversities in Medicines.—Medicines derived from the vegetable kingdom vary in quality with the soil in which they grow, the climate of the locality where, and the season in which, they are gathered, and also the care employed in their preparation. The hemp of Northern Europe possesses no remarkable medicinal qualities, while that of Asia (*Cannabis Indica*) exudes a juice which powerfully affects the brain. All extracts made from the roots and the herb of plants are comparatively worthless if obtained when the juices are diluted and feeble in the spring. The manner in which plants are dried, the degree of heat employed in obtaining their extracts, or in distilling or otherwise preparing chemical compounds, may make all the difference between an inert and an active medicine. As nearly all medicines undergo change by exposure to the air, their degree of efficacy depends greatly upon this circumstance. Many lose their active properties, including all whose virtues depend upon essential oils, or proximate principles which undergo decomposition by exposure to air or light; others, and particularly tinctures of non-volatile substances, by the evaporation of their menstruum become stronger by contact with the air; and hence narcotic tinctures, and particularly laudanum, have frequently proved poisonous when administered in the prescribed doses.

It has long been conjectured, and more recently affirmed with some show of probability, that medicines composed of different elements similarly combined in the same or in proportionate quantities, possess analogous properties. Thus iron and manganese, and also zinc and copper, which have respectively nearly the same atomic weights, present very striking analogies in their organic and therapeutical relations. Chlorine, bromine, and iodine, whose chemical properties are so strikingly alike, and whose atomic weights are in very simple relations to one another, are also singularly like one another in their curative powers. Analogous relations exist between lithium, sodium, and potassium, and also between magnesium, calcium, strontium, and barium. The action of chlorine and its associates is powerful in proportion to their several atomic weights, and the same remark is true of the alkalies and the alkaline earths.[1] These analogies, the discovery of which results from simple observation and experiment, are extremely interesting, and evidently point to

[1] Seitz, Deutsche Klinik, Nov. 1861.

a law according to which the atomic composition of bodies governs their physical constitution and their reactions with the animal economy. They therefore add to the grounds upon which substances not before used as medicines may legitimately, that is, in accordance with sound observation, be brought to the test of experience.

The *form* of a medicine influences its operation. Pulverizing a solid substance renders it more active by facilitating its solution in the gastro-intestial secretions, and consequently rendering its absorption speedier. At the same time its local action upon the gastro-intestinal mucous membrane is less intense. A small lump of camphor taken into the stomach may occasion violent local symptoms, but the same quantity dissolved in oil will not derange the stomach, but will more surely and speedily than by the other method, produce cerebral disturbance. All substances administered in powder are active in proportion to the fineness of their division. Hence, *solutions*, which are only minuter divisions of substances than powders, act more rapidly and energetically upon the system at large than the latter, while their local action is less intense. On these accounts natural mineral waters are much more active than artificial solutions containing the same ingredients.

The action of a medicine is greatly modified by its *dose*. Although such a statement needs no illustration, it may not, at first sight, be so apparent that the varied effects of the same medicine constitute one of the most precious resources in the treatment of disease. Tartar emetic in the dose of one grain, properly diluted, occasions copious vomiting, but in the dose of one-twentieth of a grain and repeated at intervals of an hour, it may, without exciting nausea, reduce the pulse in fever, and promote diaphoresis. Ipecacuanha, which in one dose vomits, in another promotes expectoration. Small doses of opium and, indeed, of all cerebral stimulants, excite the brain, but large ones stupefy it. In fact, the dose and time of its repetition affect the operation of a medicine, as much as its inherent qualities. The term *dose*, then, is a relative one; it designates a quantity which must vary with the peculiarities of the patient, and the nature and stage of his disease. Yet there is recognized for every medicine what may be called its officinal dose, and which is the quantity required to produce in an adult of average strength the effect for which the medicine is most distinguished. Thus, when it is said that the dose of opium is one grain, and of ipecacuanha twenty grains, it is understood that the former quantity will occasion sleep, and the latter vomiting, in adults presenting an average degree of susceptibility to the influence of these medicines.

When medicines are prescribed for the purpose of exerting a sustained action upon the system, they are given in *divided doses* and at comparatively short intervals of time. Often the effect is totally different from that which the whole quantity administered at a single dose would have produced. Thus, ten grains of calomel taken at once will purge, but divided into twenty doses, and given at intervals of three hours, will probably salivate. Many saline solu-

tions taken in the former manner will act as cathartics, but in the latter become diuretic. In fact most of the active substances (mercury, iodine, arsenic, etc.), which, when given in divided and even minute doses, exert a decidedly curative action in many chronic and even some acute affections, become poisons if administered at once in large doses.

The doses of medicines vary with the part of the body to which they are applied. Although it is not easy to lay down a rule on this subject which shall be of general application, the following, proposed by Œsterlen, may be usually followed. If the dose of a medicine by the stomach, say five grains, be taken as unity, the quantities required for other parts will be—

For the sound skin,	3 to 6	times,	or from	15 to 30	grains.
" ulcers and suppurating sores,	2 " 4	"	"	10 " 20	"
" endermic application,	1 " 3	"	"	5 " 15	"
" the colon (by enema),	2 " 4	"	"	10 " 20	"
" the eye,	$\frac{1}{2}$ " 1	"	"	2 " 5	"

The proper doses for hypodermic injection are not determined by this rule. Experience has indicated the following as appropriate: atropia, $\frac{1}{80}$–$\frac{1}{60}$ gr.; conia, $\frac{1}{120}$–$\frac{1}{60}$ gr.; morphia, $\frac{1}{8}$–$\frac{1}{6}$ gr.; quinia, 2–5 gr.; strychnia, $\frac{1}{80}$–$\frac{1}{40}$ gr.

Medicines are said to display a *cumulative action* when, after having been taken for some time in small and repeated doses, they appear suddenly to act as if a large dose had been at once exhibited. Such an effect is inexplicable, except upon one of two suppositions, either that the medicine has been prevented from acting by its own peculiar condition within the body, or that some sudden change in the susceptibility of the system has caused the latter to respond with undue facility. Of the second case numerous illustrations will occur to every one. An amount of alcohol that produces no intoxicating effects so long as a person is in a jovial and hilarious mood, will cause him to stagger if some unexpected and unpleasant occurrence depresses his nervous system. A stomach of sound digestive powers may reject the most wholesome food under the influence of a sense of disgust or an impression of anger or terror. But these are not the cases referred to, and there remains, therefore, the only alternative supposition that the condition of the medicine itself controls the peculiar mode of action to which reference is made. But, evidently, the condition must be one that prevents the local or general action of the medicine, or both at once; some physical obstacles, such as its being coated with mucus, or its insolubility in the gastric juices. The latter, as Dr. Fleming has suggested,[1] is probably the case when a sudden eruption of alarming symptoms follows the repeated administration of strychnia, for it is only observed when the medicine is given in a pill. More appropriate illustrations of cumulative action are furnished by digitalis and aconite. But even here the operation is more apparent than real. The last one of numerous successive doses appears to occasion poisonous effects, merely because

[1] Edinb. Med. Journ., viii. 501.

the action of the last dose administered is superadded to that of the previous doses. If their operation is carefully watched, it will be found to have been gradually developed, and that the last poisonous dose has, in reality, been acting upon a system already reduced in its power by each successive dose. Hence it is of great practical importance to watch diligently for the appropriate effects of a medicine, and so to proportion and time the doses as to prevent the occurrence of sudden and dangerous consequences.

Diversities presented by Patients. Influence of Race, Climate, Season, Time of Day, etc.—It is difficult, in reference to the present subject, to separate the influences of race and of climate, for it is generally found that the foreigner who is acclimated and has also adopted the mode of life peculiar to the native of his new residence, acquires a similar susceptibility to the action of medicines. In this respect several features distinguish the inhabitants of hot from the natives of cold climates. In the former all diaphoretic agents produce a speedier and fuller effect than in the latter, while in these the action of diuretic medicines is stronger. In warm climates there is a remarkable sensitiveness to the operation of purgatives, and the stools are apt to be very bilious. The use of mercury to produce constitutional effects is also dangerous, not only on account of its destructive effects upon the gums, etc., but also because it is apt to induce a state of nervous erethism and permanent debility. The violent effects of narcotics witnessed among Oriental nations are unknown among the inhabitants of the temperate regions of the West. Even between the north and south of Europe a similar difference has been observed; and Dr. Harrison affirms that in Naples patients were made amaurotic by the same doses of extract of hyoscyamus they were accustomed to take in England. In this case something was probably due to the greater strength of the Italian extract. Albers states that the inhabitants of elevated tracts of country tolerate smaller doses of medicine than those of the seaboard, and that Hollanders require twice as large doses as the inhabitants of Bonn. He also mentions that Englishmen residing in the latter place are obliged to employ smaller doses of medicine than they were accustomed to use at home. The remarks just made respecting climates are in some degree applicable to differences of seasons, when these are extreme, as in the United States. Thus, during the protracted heat of certain summers in this country, there is a general tendency to irritability of the bowels, and an increased susceptibility to the stimulant action of narcotics. In this connection the *epidemic constitution* is deserving of notice. With a tendency to susceptibility of the bowels, such as prevails during epidemics of cholera, the smallest doses of purgative medicine produce hypercatharsis; when diseases all assume a bilious type, such remedies are, on the contrary, well borne; and during the prevalence of a typhous constitution, alcoholic and other stimulants may be required in diseases which usually call for a vigorous antiphlogistic treatment.

The *time of day* when certain medicines are taken influences their

mode of operation. It is well known that the vital functions pass through different cycles of activity during successive portions of the twenty-four hours. The economy possesses a maximum power of resistance to hostile impressions when it has been renovated by the night's repose, but which gradually declines until exhaustion once more induces sleep. Hence all narcotics and all medicines intended to produce indirect sedative effects, *e. g.*, by diaphoresis, are most efficiently given in the evening, when the natural tendencies of the system conspire to promote their action. This time, also, is to be preferred for the administration of cathartics of slow and gentle operation, and, in general, of all medicines which are intended to be absorbed and to remain in the system. On the other hand, the prompt and thorough operation of evacuant medicines whose nature is to produce a speedy reaction is most effectually secured by their administration early in the morning, when the stomach and bowels are least replete, and the vigor of their functional actions is most perfect. This remark is peculiarly applicable to saline cathartics.

An attempt has been made to determine the peculiar susceptibilities of the several *temperaments*. It has been said, in general, that the nervous and sanguineo-nervous temperaments are affected by small doses of medicines, and particularly by those of the stimulant and narcotic classes, whereas the phlegmatic and bilious temperaments imply a remarkable insensibility to the operation of drugs. It is only in marked examples of the several temperaments that distinctions like those alluded to become of real value, and such cases are comparatively rare.

Age.—It seems but natural that medicines should operate differently in the earlier periods of life, on the one hand, when the function of nutrition and the nervous susceptibility are in their fullest exercise; and, on the other, in adult life when both organic and animal functions are stationary, and finally in old age when both are tending to decay. During infancy and childhood more dependence is to be placed on the recuperative powers of nature than upon the operation of drugs; and at none other is inconsiderate drugging so full of mischief. At this age all injuries to the organism are repaired with wonderful rapidity, and even when the functions are so exhausted that death seems inevitable, recovery often takes place by the sole power of the vital force. Therefore, it is said, "Childhood is the age of resurrections." Appropriate diet, and the exclusion of all disturbing influences are then the essential remedies in acute affections, and change of air and food in chronic diseases. But as, in many cases, this expectant method will not suffice, and medicines must be given, those should be selected which operate mildly, and which, even in an overdose, are not dangerous. As a general rule, depletion should be avoided; the cases are very rare in which it is necessary until after the seventh year, and they are not frequent even during adolescence; for other evacuants, at this period, impress the system powerfully. Blisters should always be

applied with care, in infancy, lest sloughing be produced. Of internal medicines the mineral acids, and the metallic salts, especially those of mercury and arsenic, are to be avoided. As mercury rarely salivates children under the age of three years, we are deprived, in their cases, of a criterion by which to graduate its dose. Antimonials, even in minute doses, sometimes depress the system of young persons to a dangerous degree, and may even operate as fatal poisons. A similar remark is applicable to narcotics, particularly when administered to children exhausted by sickness. In the Article on Opium illustrations of this statement will be found.

In old age, also, depletion must be used with extreme caution, and, when necessary, the sinking which it is apt to cause must be guarded against by gentle stimulants. Indeed, the latter should be associated with nearly all the methods of treatment used for old persons, for "wine is the milk of old age." Purgatives are generally required in larger doses than for adults, and should, as far as possible, be selected from the resinous class, and associated with bitter tonics. Salines are, for the most part, to be avoided. Blisters and rubefacients must be cautiously employed on account of the impaired vitality of the skin, and, on the same account, the endermic method is not eligible in old persons. Metallic preparations are usually to be avoided as much as during childhood, and narcotics are apt to produce serious congestion of the brain. This is particularly the case with opium. Attempts have been made to form a scale of doses of medicines appropriate to the different periods of life, and, although none of them can be considered accurate, they may serve as guides until personal experience renders them unnecessary. The table of Gaubius is one of the simplest, and is as follows. The dose for an adult being taken as unity,[1] there may be given to persons

Under one year	$\frac{1}{15}$ to $\frac{1}{12}$	of the dose.	At 7 years	$\frac{1}{3}$	of the dose.
At 2 years	$\frac{1}{8}$	of the dose.	" 14 "	$\frac{1}{2}$	"
" 3 "	$\frac{1}{6}$	"	" 21 "	$\frac{2}{3}$	"
" 4 "	$\frac{1}{4}$				

[1] Hufeland considered a full dose the quantity which may be taken between the ages of 25 and 50 years, and the following table is presented as a result of his experience:—

$\frac{1}{2}$ to 1 month	$\frac{1}{2}$ to 2	parts.	3 to 4 years	16 to 18	parts.
1 " 2 months	2 " 4	"	4 " 5 "	18 " 20	"
2 " 3 "	4 " 5	"	5 " 10 "	20 " 25	"
3 " 4 "	5 " 6	"	10 " 20 "	25 " 35	"
5 " 7 "	6 " 7	"	20 " 25 "	35 " 40	"
7 " 9 "	7 " 8	"	25 " 50 "	40	"
9 " 11 "	8 " 9	"	50 " 70 "	40 " 30	"
1 " 2 years	10 " 13	"	70 " 80 "	30 " 25	"
2 " 3 "	13 " 16	"			

Albers gives the following table formed from careful observation:—

Age	Dose.	Age.	Dose.
1—60 days . .	$\frac{1}{10}$	15—20 years . .	$\frac{3}{4}$
2—12 months .	$\frac{1}{8}$	25—60 " . . .	1
1— 5 years . .	$\frac{1}{3}$	60—70 " . . .	$\frac{7}{8}$
5—10 " . .	$\frac{3}{8}$	70—90 " . . .	$\frac{7}{8}$
10—15 " . .	$\frac{1}{2}$		

A simpler method than the above, or than those given in the note, is that of Dr. Young, viz.: For children under twelve years the doses of most medicines must be divided in the proportion of the age to the age increased by 12; thus at two years the dose would be $\frac{2}{2+12}=\frac{1}{7}$ This formula is in fact an approximate generalization of the table of Gaubius, but both differ materially from the tables in the foot note, except for the years between 10 and 15.

Sex.—As, in general, females are more susceptible to impressions than males, the action of medicines upon them is apt to be more prompt, active, and irregular, than in men; and, therefore, it is generally advised that medicines should be administered to them in smaller doses. But this rule is by no means of universal application. There are masculine women and effeminate men in great numbers, and in constitution even more than in character. But even apart from this circumstance, women support active treatment, as they do surgical operations, better than men. They are more easily affected than men by narcotic and other nervine stimulants, but they are not more susceptible than the other sex to the operation of purgatives. During menstruation, pregnancy, and lactation, the female constitution acquires peculiar susceptibilities. At these epochs all active treatment, which is not imperatively demanded, should be avoided, and the use especially of strong emetics and cathartics and all painful applications. Iodine and mercury must be cautiously administered in pregnancy; and during lactation all medicines not absolutely necessary, which are capable of impregnating the milk. Of these opiates are especially to be guarded against. Bitter vegetable substances, also, are apt to impart an unpleasant flavor to this secretion, and indispose the child to nurse. At the menopause great circumspection in the use of medicines is required, on account of the peculiar susceptibilities, at this epoch, derived from the reproductive organs, and also because it is then that many organic diseases originate, which may, by injudicious treatment, be hurried into a premature development.

Habit.—The same power which the human constitution possesses of adapting itself to every variety of climate and mode of life, is shown by the operation of medicines upon it. When these do not tend to disorganize the tissues, they gradually lose their power of exciting reactions in the system, and, therefore, must be administered in gradually increasing doses. Alcoholic liquors, which occasion intoxication very speedily in those who are unused to them, may, as it is well known, at last be taken in as large quantities as the stomach will hold without producing their former characteristic effects. Opium eaters learn to use enormous quantities of this drug without experiencing narcotism. Trousseau mentions the case of a woman who was in the habit of consuming nearly an ounce of opium every day. Purgative medicines also gradually lose their

power of stimulating the intestine, a circumstance which renders the treatment of habitual constipation by them extremely unsatisfactory. It is difficult to account fully for this peculiarity; but we know that it is a property of animal organization. It may, to some extent, be due to the saturation of the tissues at the point of application, with a medicinal substance, but is, more probably, attributable to the nervous system. We know that a peculiarity of the sentient part, if not of the whole, of this system, is to pass through periods of alternate action and repose, and that the latter state is always proportioned to the former, in duration and degree. If the action be violent or prolonged, the reaction or exhaustion will be extreme and protracted. We know, further, that repose restores a function to its original vigor; as sleep refreshes the exhausted body, so does the suspension of a particular stimulation allow a part to regain its original susceptibility. In recovery from the fatigue produced by muscular and mental exertion, it is evident that the recuperation, if not literally vital, is at least restricted to the organ of animal life, the nervous system. Hence, whatever merely physical causes may tend to lessen the susceptibility to medicines which are repeatedly given, we must not leave out of sight the important law of the nervous system which has been referred to. An apparent exception to the law that medicines must be given in increasing doses to maintain an uniform effect, is to be found in mercury. When once the system has been brought under its influence, very small additional doses will renew the original manifestations of its action. In this case, and in that of lead and some other substances, the medicine saturates the economy, and remains in it for a long time. Every additional dose, therefore, even though a small one, may be expected to develop its peculiar effects. That this is a correct explanation of the peculiarity in question is rendered highly probable by the fact that iodide of potassium given to persons saturated with mercury or lead, will often develop salivation in the one case, and cause an abundant discharge of lead with the urine in the other. Another exception is presented by the operation of emetics, provided they are not administered in rapidly successive doses. In the latter case they obey the general law, and "toleration," or insensibility to their action, is speedily induced. But in the former instance, equal effects may arise from progressively smaller doses, and at last the idea, even, of the emetic medicine may excite nausea. This fact is to be explained by the influence of mental states in general, upon the functions of the stomach. Diaphoretic medicines appear, also, not to fail of their effect when frequently repeated. Indeed, when they have been used for a long time, diaphoresis may be excited by a variety of stimulant influences which ordinarily would not produce such an effect.

Idiosyncrasies.—Many persons are affected by certain medicinal or other agents, in a manner quite peculiar to themselves, and of which no rational explanation can be given. Usually it is a per-

manent peculiarity, in other cases it exists only during menstruation, pregnancy, or the exacerbations of some nervous disorder. We have known a gentleman who was always attacked with coryza if the smallest quantity of powdered ipecacuanha approached his face. Nor are such cases very uncommon. This medicine more frequently occasions a paroxysm of dyspnœa. Albers relates that a person whose mother also evinced the same peculiarity, experiences pains in the umbilical region whenever her feelings are affected, either agreeably or the reverse; and medicines which, like mercury and tartar-emetic, are somewhat irritating, produced the same effect. Marc has collected a large number of cases bearing upon this subject, and the following, selected from among them, may suffice for illustration.[1] Haller mentions a female whom syrup of roses purged violently; Whytt one in whom a dose of magnesia caused shuddering and unusual trembling; Tissot refers to a person whom the smallest quantity of sugar caused to vomit; Déjean reports a case in which honey, either internally or externally, acted as an irritant; Wagner, an instance of a person who vomited on taking the least dose of rhubarb, and Marc relates the same peculiarity of himself. In other cases opium has caused salivation, wakefulness, itching, or vomiting, vinegar hemorrhage, mercury in the minutest dose salivation, quinia violent headache, etc. These and similar examples which, in the aggregate, are very numerous, and the still larger number which, without being so eccentric, are still departures from the general rule, ought not to be lost sight of by those sanguine philosophers who think it possible to reduce the operations of the living organism to laws as fixed as those of chemistry or physics.

Mental Influences.—Sentiments of partiality or aversion, and, indeed, preconceived ideas of whatever sort, respecting the operation of medicines, in many instances, determine their effects. The cures of the charlatan, whether he be an itinerant vender of panaceas, or a smug exhibitor of mesmeric jugglery, and those of the self-deluded enthusiast confident in an imaginary power, are often real, and at times so wonderful as to pass with the populace for miraculous. Yet they nearly all depend upon the patient's being impressed with a firm faith in the success of the prescribed remedy. The same power, honestly employed, is the secret of the success of many physicians who, inferior, perhaps, to others in knowledge of disease and the use of the medicines, are superior to them in their ability to control the will of the patient, and inspire unquestioning faith in the remedies which they employ. Philosophy is never so out of place as at the bedside of the sick. By a judicious use of the patient's belief, not only may recognized medicines become the means of accomplishing purposes which they are physically incompetent to fulfil, but inert matter, imbued with faith, may produce important physical effects. Simple neutral substances, such as a few grains of salt, or bread pills, may induce vomiting or

[1] Dict. de Méd. in 60 vol., xxiii. 498.

purging; some colored drops may assuage a violent nervous headache, excite diaphoresis, or promote sleep. In this connection, it is sufficient to refer to the salutary influence of cheerfulness and hope, and the depressing effects of a dull tone and despairing manner, not only on the comfort of the sick, and their progress towards health, but absolutely on the issue of their illness.

Influence of the Form of Disease.—It has already been noticed how wide a difference there often is between the operation of medicines in health and disease. It should be borne in mind that whenever the secretory function is impaired, from whatever cause, absorption also is less active than natural; in all fevers and sthenic inflammations mercurials and narcotics operate slowly; when the kidneys are inflamed, stimulant diuretics only diminish the secretion of urine, and when the bronchia are in like condition, direct expectorants are mischievous. In those cases it may be conjectured that the very infarction of the affected organs with blood prevents the medicines from reaching their secreting vessels, and from being eliminated. In febrile affections of a low grade, with more or less torpor of the nervous system, and even in the functional depression of the brain which marks some forms of insanity, in cerebral oppression by serum or blood effused within the cranium, the susceptibility of all the organs is impaired, and emetics, purgatives, etc., operate only in unusual doses. Still more remarkable is the insusceptibility to narcotics in certain nervous affections, as delirium tremens and tetanus. In a word, whatever conclusions regarding the action of medicines may have been reached by experiments upon the healthy, or by general observation of the sick, every new case may present special modes of this action depending upon conditions peculiar to the patient's constitution, and the nature, stage, or complications of his disease.

The Administration of Medicines.

THE FORMS IN WHICH MEDICINES ARE EMPLOYED.

The physical qualities of a medicine, its solubility, bulk, taste, etc., determine in some degree whether it shall be given as a solid, liquid, vapor, or gas; but the use of one or the other of these forms also depends upon the natural character of the part to which it is to be applied, and the susceptibility it may have acquired or lost in disease. As a general rule, that form should be selected which is most favorable to the proposed operation of the remedy, the solid being preferable when a local action only is contemplated, and a liquid or gaseous form when absorption of the medicine is intended. Between these two extremes there are preparations which graduate the solubility of medicines, by presenting them to the absorbing surface in a more or less finely-divided condition, or in union with substances which facilitate their administration, and regulate the rapidity with which they can be absorbed. The following are in general use.

Powders (*pulveres*) are obtained by pounding, grinding, filing, levigation, precipitation, etc. Their general action is most marked when they are most finely divided. Thus, a substance obtained by precipitation is more active than the same procured by pulverization, as in the case of milk of sulphur and washed sulphur. On the other hand, a coarse powder, while it is less readily absorbed, exerts a more powerful local action, and one which may even become poisonous, as in the case of the metallic salts. Hence, it is a general rule to administer only the finest powders, and also to prevent their aggregation in masses by means of some excipient in which they are uniformly diffused. Sugar, gum, powdered extract of liquorice, etc., and, in the case of light powders, water sweetened or otherwise flavored, are used for this purpose. If it is intended to render the action of the medicine gradual, an insoluble excipient, such as powdered liquorice root, may be selected. For substances which are to be absorbed from the stomach and bowels, and which must be repeatedly administered, this form is ineligible; for the powder is apt to occasion disturbance of the digestion, or to accumulate in the intestinal canal.

Confections (*confectiones*) contain the leaves, seeds, or other parts of fresh plants mixed with honey or sugar. But few medicines are exhibited in this manner, because the proportion of saccharine matter contained in them is objectionable. Laxative confections, as the confection of senna, are exceptions to the rule.

Pills (*pilulæ*) are small globular masses weighing from one to four grains, or if metallic, not more than from six to eight grains, and containing one or more medicinal substances. When these are not sufficiently cohesive, they are rendered so by the addition of a vegetable extract, or gum, soap, syrup, or honey. They are prevented from cohering, when placed together, by being sprinkled with lycopodium, liquorice powder, or magnesia, and their taste may remain unperceived if they are coated with gold or silver leaf, or with sugar or gelatin, which are preferable from their greater solubility. Two small cylindrical capsules of gelatin, made to fit into one another by their open ends, and of a size sufficient to hold a pill, are sometimes used for administering this form of medicine. Nearly all pills should be used before they become hard. Those composed of resinous materials are especially liable to objection if this precaution be not observed. Slow solution is occasionally advantageous; thus old opium pills are preferred in cases of intestinal colic with diarrhœa, because they extend their local action over a larger surface of the bowel.

Boluses are large and soft pills; they are sometimes formed of confections, and are best administered in wafers made of flour and the white of egg. Liquids of an offensive taste, and which are given in small doses, such as copaiba, various essential oils, etc., are sometimes inclosed in ovoid gelatinous capsules which effectually prevent their taste from being perceived.

Troches (*trochisci*) are, properly speaking, flattened disks (*rotulæ*), with rounded serrated, or otherwise formed edges, made usually

with gum and sugar, and more or less medicated. Some medicinal preparations of a cylindrical form (*bacilli*) are incorrectly called *lozenges*. They are intended to dissolve slowly in the mouth, and to maintain the moisture of the fauces, as well as exert some medicinal effect upon the latter, or upon the system generally.

SUPPOSITORIES (*suppositoria*) are small conical or ovoidal bodies made of oil of theobroma and variously medicated. They are applied chiefly to the rectum and the vagina.

Several solid forms of medicines are used exclusively for external application. Among these are CATAPLASMS or POULTICES, which are made of soft materials (generally bread-crumbs, flaxseed meal, or Indian corn meal), capable of retaining moisture and of closely covering the part to which they are applied. A tissue, called *spongio-piline*, has been invented to fulfil the same indications. These applications are used as vehicles for heat, moisture, and various anodyne, astringent, rubefacient, and other medicines. *Ointments* (UNGUENTA) are medicated preparations of fats and oils for external use. *Cerates* (CERATA) differ from ointments in containing wax, which gives them a firmer consistence than these latter. Both are employed to protect irritable portions of the skin from the air, and at the same time to apply medicinal substances incorporated with them. Generally they are used to allay irritation, but sometimes, on the contrary, to produce it, as in the case of ointment of cantharides, of tartar emetic, etc. In *plasters* (EMPLASTRA) the basis is an adhesive substance, generally resin, wax, or a compound of oil and litharge, and they are intended to adhere to the skin so as to give it and the subjacent parts support, while it protects them from external impressions, and by means of medicinal ingredients acts directly upon the integument, or on the parts beneath it, or through these parts upon the rest of the economy.

EXTRACTS (*extracta*) "are solid substances resulting from the evaporation of the solutions of vegetable principles." Alcohol, ether, acetic acid, and water, are the menstrua usually employed for this purpose, when extracts are not procured by inspissating vegetable juices. They vary in consistence from that of a soft paste to that of a hard and brittle solid, and may be administered in pill, solution, or mixture.

The *liquid forms* of medicines are those which contain their active properties in water, alcohol, ether, vinegar, honey, glycerin, or oil. They are administered both internally and externally. Of the different menstrua named, some extract certain constituents only of natural bodies, and others certain other constituents. The most general solvent of medicinal elements is alcohol, and next to it water and glycerin, but each extracts most perfectly what it is competent to dissolve, when it is aided by heat.

The following are the principal liquid forms in which medicines are administered.

MIXTURES (*misturæ*), as distinguished from solutions, are liquid preparations containing one or more ingredients, which are not perfectly soluble in any suitable liquid. Resinous substances are

precipitated from their tinctures on the addition of water, and hence all resins and gum-resins, prescribed in an aqueous vehicle, must be suspended by means of mucilage, albumen, sugar, or some equivalent substance. Other medicines, whose weight, as well as insolubility, renders them difficult of administration in water, are given in this manner. Chalk mixture, ammoniac mixture, and the compound mixture of iron are examples of this form of preparation. An *emulsion* is, properly speaking, a mixture in which oil and water are mixed by means of mucilage, or albumen and sugar. The ingredients for making this preparation sometimes exist in nature, as in the seeds of various fruits, *e. g.*, the almond. A *julep* is a sweetened or acidulous mixture, but the term is often applied to mixtures generally.

Solutions (*liquores*) contain the active principles of non-volatile substances, water being generally the solvent. Vinous, acetous, and other solutions are described as *wines*, *vinegars*, etc.

Infusions (*infusa*) are watery solutions prepared by digesting vegetable substances in cold water, or in hot water below the boiling-point, so as to separate their active from their inert portions. Cold water is preferable as a menstruum, when the medicine contains a volatile principle which may be driven off by a moderate heat, and also when it contains starch, which would cause the infusion to ferment, unless kept at a low temperature. But, although hot water is liable to this objection, it has the advantage of coagulating vegetable albumen, which is contained in all vegetable juices, besides extracting a larger proportion of the medicinal ingredient. Infusions are prepared by simply macerating medicinal substances in water, or by *percolation*.

Decoctions (*decocta*) are watery solutions of fixed vegetable principles obtained by boiling. They have the advantage over infusions of greater rapidity in the preparation, and greater strength, but the disadvantage of a loss of the volatile principles of the substance employed. The latter objection may be diminished by conducting the process in a covered vessel, and for a short time only.

Fluid Extracts (*extracta fluida*) are inspissated solutions of the active properties of vegetable substances obtained by means of glycerin and alcohol. The method of displacement is generally employed in their preparation, and the resulting solution evaporated to a proper consistence.

Medicated Waters (*aquæ*) are prepared by the distillation of water from dried, or, preferably, from fresh vegetable substances, or by mechanically impregnating pure water with a medicinal agent. Of the latter description are carbonated and camphor water; of the former, the aromatic waters, as formerly made. They are now, however, prepared in a more expeditious manner, by impregnating water with essential oils through the intervention of carbonate of magnesium. This method, which is officinal, produces a stronger water than the other method, but one destitute of the delicacy which the old process secured, and which is still retained for certain preparations.

Tinctures (*tincturæ*) are solutions of medicinal substances in alcohol. Their Latin name is derived from the circumstance of their being always colored. The only exception to this rule is tincture of camphor. They become more or less turbid on the addition of water, which combines with the alcohol and precipitates the substance dissolved in it.

Spirits (*spiritus*) are alcoholic solutions of volatile principles prepared by distillation, or, as is now the custom, by dissolving the volatile principles in alcohol or diluted alcohol.

Wines (*vina*) are solutions of medicinal substances in Sherry wine. They differ from tinctures and spirits in containing less alcohol, and being, therefore, less stimulating.

Vinegars (*aceta*) are preparations in which cold distilled vinegar or diluted acetic acid is used to extract the active qualities of medicines. They have no special advantages, and except the vinegar of opium, or *black drop*, and the vinegar of squill are but little used. The former preparation is supposed to exert a less stimulant effect, and to derange the stomach less, than the tinctures of opium.

Syrups (*syrupi*) "are concentrated solutions of sugar in watery fluids, either with or without medicinal impregnation." They serve to prevent decomposition in vegetable substances, and to mask the disagreeable taste of numerous medicines. Without great care they are liable to ferment.

Honeys (*mellita*) are solutions of medicinal substances in honey. They are seldom used internally, sugar having taken the place of honey in numerous preparations which were formerly made with the latter.

Glycerites (*glyceritæ*) are solutions of certain substances in glycerin which are insoluble or imperfectly soluble in water or alcohol. They are chiefly employed externally.

Gases and Vapors.—A few substances have been used in the gaseous form for medicinal purposes. Such are oxygen, chlorine, and carbonic acid. But they have not answered the expectations originally formed by those who proposed them. *Vapors* have, in great variety, been applied to the skin and the bronchial mucous membrane for the cure of diseases. In the former case the patient is inclosed, except his head, in a wooden box or other convenient receptacle, and surrounded with the fumes of the substance which is intended to act upon him. The vapors of mercury and its compounds, of sulphur, iodine, etc., have been used in this manner. Inhalation is used for introducing a variety of medicines into the system, through their rapid absorption by the pulmonary veins. Sometimes the apartment occupied by the patient is impregnated with vapors, such as those of chlorine and tar; in other cases the patient is made to breathe from a sponge, or cloth, or an instrument called an inhaler, the emanations of volatile agents, such as ether, chloroform, and various narcotic tinctures. The fumes of certain substances in combustion, such as stramonium, opium, bella-

donna, camphor, nitre, may be inhaled through such an instrument, or a common tobacco pipe.

The Art of Prescribing.

An essential preliminary to the successful use of medicines, is an accurate knowledge of the disease they are employed to cure: not a knowledge of its intimate nature, but a recognition of those phenomena by the enumeration of which it is defined, and which enable us to discriminate between it and all analogous morbid conditions. An acquaintance with its intimate nature would not lead to the discovery of its cure. The cure of intermittent fever, of whose nature we are ignorant, is easier than that of pneumonia, the anatomical elements of which are known. Without such knowledge, experience is deceptive and valueless; and, on the other hand, when it is possessed by those who investigate the curative effects of medicines, it gives to their results a precision which is at once recognized by the medical world and permanently modifies the healing art. Hardly less important as a groundwork for therapeutics, is the recognition of the various states which a patient may pass through in the course of a disease. In the greater number of diseases, in all, indeed, which are not of a specific nature, the appropriate curative remedies are very different at different periods of the attack. Medicines are prescribed for the purpose of bringing about, or of promoting certain changes, the evolution of which belongs to the normal progress of the disease. According to its nature the remedies must vary, and, during its course, may require to be of dissimilar, or even opposite natures; for it constantly happens that an attack which has called for sedatives at its commencement, requires stimulants before its close. The successful practitioner is not he who, besides possessing diagnostic skill, is abundantly furnished with medical prescriptions for all diseases, but he who, in each particular case, knows not only what are the remedies adapted to remove the dominant and permanent morbid element, but also what are the appropriate means of dissipating every subordinate derangement and of influencing every function in such a way as to concur in the prime object of bringing the disease to a safe termination. This is a knowledge which can be very imperfectly obtained from books. It is the result, in most cases, of long practice by a man whom nature has fitted for its attainment. Few physicians are so highly endowed. It can only be communicated to pupils by a skilful teacher, in daily or still more frequent visits at the bedside of the sick. We renounce, therefore, any attempt to reduce such knowledge to written rules. In this place, we shall merely endeavor summarily to describe the conditions affecting the successful employment of medicines which arise out of the mode in which they are administered.

Medicines may be incompatible with one another because their modes of action are different, or because their chemical constitution involves their mutual antagonism or their decomposition. To unite

such medicines in the same prescription appears to be illogical; and, undoubtedly, in physics, if opposing forces so combined are of precisely the same amount, and of exactly opposite natures, they neutralize and destroy one another. But in medicine it is far otherwise in the greater number of cases. A third substance may arise from the union of two, possessing in a mitigated degree the properties of both. Hence a large number of the most efficient medicines owe their virtues to being compounded of antagonistic substances. Just as in dietetics and the culinary art, the due admixture of the strong and weak, the acid and the sweet, of animal and vegetable food, produces compounds the most agreeable to the palate and the easiest of digestion, the union of a stimulant and a sedative, as of opium and ipecacuanha in Dover's powder, produces an effect which neither is competent to produce alone. Indeed, however desirable simplicity in formulæ may be, there is every reason to believe that the skilful association of medicines of different qualities is one of the most important, as it is one of the most difficult, departments of therapeutics. It was anciently, and, until the present century, a universal practice; and if the formulæ of other ages appear to us monstrous from the number and incongruity of their ingredients, we should remember that they only prove the abuse of a principle which is founded in truth. Although it cannot be denied that it is much easier to judge of the operation of remedies when they are given singly, it may not also be easier at the same time to cure diseases by simple prescriptions. It is perhaps not wise to reject the experience of ages for the sake of a doctrine which is not yet proven to be true.

It may be urged, and it is very certain, that simplicity is preferable to complexity in prescriptions, whenever the end in view can be attained by the former; and it must also be admitted that routine and an almost superstitious want of discrimination engendered the farrago of drugs in many old formulæ. The chemical and other experimental researches of modern science have also revealed, more clearly than they were known before, the limits of the powers of medicines, and banished from the pharmacopœia numerous substances entirely destitute of medicinal efficacy. Yet it is none the less certain that the more simple, convenient, and, as they are termed, elegant preparations of modern pharmacy, are far from possessing, in all cases, the virtues of the drugs from which they are procured, and to which they are assumed to be equivalent. Morphia is not the equivalent of opium, nor quinia of cinchona, nor, we feel assured, does any simple combination of the former with an aromatic or an astringent possess the precise qualities of those "monstrous compounds" theriaca and diascordium.

Substances which are regarded as chemically incompatible, may nevertheless be medicinally efficacious. Yellow wash and black wash are valuable applications to certain forms of ulcers, yet the one results from the mixture of the chemically incompatible corrosive sublimate and lime-water, and the other from that of calomel and lime-water. Acetate of lead and opium, forming one of the

most frequently used of all combinations for arresting internal hemorrhage, etc., produce acetate of morphia and an insoluble meconate of lead. In this, and in many similar instances, it is possible that the acid secretions of the stomach, or the alkaline ones of the duodenum, may restore the precipitated compound to activity by rendering it soluble anew. How far this restorative agency may be exercised in other cases of apparent incompatibility it remains for observation and experiment to decide. Medicines intended for external application have not the benefit of this influence, and care should be taken, in prescribing them, lest an insoluble compound be produced which cannot be advantageous, and may prove irritating. Solutions of nitrate of silver, or acetate of lead, intended to be applied to the eyes or to an ulcerated surface, should not be associated with a vegetable astringent, for they will form insoluble compounds with its tannin. Or, if laudanum be added to such solutions, insoluble meconates of lead or silver are produced.

The *doses* of medicines are the quantities ascertained by experience to be necessary for producing their curative effects. We have elsewhere referred to the different action of medicines in health and in disease. In the former, as a general rule, larger doses are necessary to produce effects than in the latter, because the power of resistance in the organism is greater, and the susceptibility of the parts to which medicines are applied is less. But the reverse of this is sometimes the case, and through disease, either local or general, the susceptibility of a part or of the whole organism is blunted. These extreme conditions being recognized as capable of modifying the doses of medicines, it is evident that the latter must also vary with every degree and kind of departure from health; in different diseases, that is, and in the several stages of each disease. The standard dose of a medicine is, therefore, to be regarded as an indication, but not as a rule, for its prescription. The age and sex of the patient, the nature, stage, and complications of the disease, and innumerable incidents determined by the peculiarities of the individual case, must all be allowed a degree of influence in determining the first dose of a medicine. Afterwards its increase or diminution must be decided according to the effects which it produces, or seems to produce.

No more difficult problem exists than to determine how far the phenomena succeeding the administration of a medicine are due to the latter. To impute them all to it when they are favorable, and to the disease for which it is given when they are otherwise, is, perhaps the natural tendency of the mind, and it certainly is the resource of charlatanism. But the more closely the natural history of disease and the effects of remedies are studied, the more evident does it become that we are in the habit of attributing too little efficacy to the curative energies of the system, and too much to medicines. If it were always possible to determine what precise effect should be produced, and what remedy and what doses of it are required for the production of that effect, medical art would soon assume the consistence of a science, and the results of its prac-

tical application might be predicted with certainty. But, in the absence of any such groundwork, our art can be only tentative; and, even when we have selected the appropriate remedy, the precise mode in which it is to be applied can seldom be determined until several or even many doses of it have been administered. To do so with the greatest advantage implies the possession of a degree of therapeutical sagacity which is one of the rarest of natural gifts.

In many, indeed in most diseases, the condition which renders a certain dose of a medicine necessary at one stage having been palliated or removed, it is useless or injurious to continue the same dose. But when, and in what degree and manner to modify it, is often a difficult question to decide. All medicines, it must further be borne in mind, create an artificial condition of the system, and, if they are repeated frequently, this condition, whether directly or indirectly produced, grows habitual, and may at last become a morbid state. Hence the necessity of generally augmenting the doses of medicines in order to produce their original effects. But if the susceptibility of the system to them becomes exhausted, as well as its original power of action, a state of torpor ensues which may involve serious consequences. When purgatives have been injudiciously employed to overcome habitual constipation, the bowels may at last cease altogether to respond to appropriate excitants. The case is still worse when a similar influence operates upon the whole system. This is not unfrequently observed in typhoid conditions when stimulants to an exorbitant amount, or too often repeated, cease to produce a response, and the patients sink exhausted into a collapse, or into a state of fatal stupor. Amidst these and similar embarrassments the safest rule is to use no more of a medicine than is requisite to produce the effect which is intended, and to continue it no longer than is absolutely necessary. It cannot be too often repeated that every mere drug when used unnecessarily is not only superfluous but mischievous.

Classification of Medicines.

Many attempts have been made to form a scientific classification of the Materia Medica. The botanical, mineralogical, and chemical arrangements, although recommended by several eminent names, are totally useless to the physician; and the physiological, in consequence of its assuming, as a basis of therapeutics, principles which are transient and uncertain, is only a delusive guide. Some writers have despaired of devising an arrangement or nomenclature at once rational and useful, and have taken refuge in an alphabetical catalogue of the articles of the Materia Medica. The sole merit of this plan is, that it facilitates research in works intended to be used rather for occasional reference than for systematic study. It is destitute of that suggestive power which belongs to natural classifications, and by which one article recalls others of the same nature that may be substituted for it with more or less advantage.

The most ancient, the most generally employed, and the most

convenient classification of medicines is their arrangement in groups corresponding to their sensible operation upon the economy. The original foundation of practical medicine consisted in an attempt to promote the critical phenomena of disease, or, where these did not appear, to imitate them. It was observed that they usually consisted of evacuations from the lungs, stomach, bowels, kidneys, skin, etc., and as it became known, by accident or by experiment, that certain substances occasion similar discharges, they were employed for this purpose in disease. In process of time, and with a more careful observation of the effects of medicines, it became evident that many of them which appeared to be simple, are in reality complex; that many medicines, analogous in their general effects, are yet dissimilar in their secondary or subordinate operations; that many which were regarded as acting upon individual organs, as a whole, in reality confine their operation to certain of the anatomical elements; that many natural medicinal substances are composed of two or more active and sometimes discordant elements, etc. Such results of observation led, of necessity, to an extension of the original and natural classification, and to the formation of new classes, or a subdivision of the old. By some writers these subdivisions have been unduly multiplied and extended. A solicitude to provide shelter for remedies which might be claimed as fugitives from an older and more legitimate domicile appears to have induced this unnecessary multiplication of classes, and the invention for them of names which it is irksome to remember, and which are not always justified by ulterior experience. Undoubtedly the progress of physiological discovery has not only enabled us, but made it our duty, to discriminate between medicines which were once united under a common appellation. It is now certain, for instance, that the nervous and the vascular systems, or the brain and the spinal marrow, may, to a greater or less extent, be influenced by certain medicines independently of one another, and it is therefore proper that such distinctions should be recognized in our classifications and nomenclatures.

In the arrangement proposed below, several of these distinctions are observed, and an order of classes is adopted, the general plan of which is that it ascends from the simpler to the more complex forms of medication. At one of its extremities will be found emollients, the action of which is very simple, and for the most part mechanical; while at the opposite end of the ascending scale the class of alteratives is placed, whose mode of cure is inexplicable in the present state of our knowledge.

It will be found that the several classes do not always comprise the same articles which they include in other works. Many, if not all, medicines display diverse qualities according to their dose, combinations, mode, and time of administration, etc., but, as every one possesses some predominant virtue, on account of which it is most frequently prescribed, this circumstance has usually determined the author's choice of its position. In that place its subordinate as well as its cardinal qualities will be examined.

In presenting this arrangement of the Materia Medica, the author is not only aware that, like all others that have been proposed, it is obnoxious to criticism, but he is quite alive to its numerous, if inevitable, defects. While he has endeavored, in framing it, to avoid some of the errors which he believed to exist in other plans, he has become their debtor for the chief portion of whatever merits his own may possess.

CLASSIFICATION.

I.	Medicines which allay local irritation.	LENITIVES.	
II.	Medicines which repress local action.	ASTRINGENTS.	
III.	Medicines that irritate the part to which they are applied.	IRRITANTS.	
IV.	Medicines which promote nutrition.	TONICS.	
V.	Medicines which stimulate the whole economy.	GENERAL STIMULANTS.	
VI.	Medicines which stimulate the cerebro-spinal system.	CEREBRO-SPINAL STIMULANTS.	Narcotics. Antispasmodics.
VII.	Medicines which especially stimulate the spinal nervous system.	SPINANTS (*Tetanica*).	
VIII.	Agents which depress the whole economy.	GENERAL SEDATIVES.	
IX.	Medicines which depress the vascular system.	ARTERIAL SEDATIVES.	
X.	Medicines which depress the nervous system.	NERVOUS SEDATIVES.	
XI.	Medicines which produce a discharge from particular organs.	EVACUANTS.	Epispastics. Errhines. Sialagogues. Emetics. Cathartics. Expectorants. Diaphoretics. Diuretics. Emmenagogues. Anthelmintics.
XII.	Medicines which modify the nutrition of the body without producing any antecedent phenomena.	ALTERATIVES.	

Class I.

LENITIVES.

Lenitives are medicines which, mainly by a local and mechanical action, allay irritation.

They owe this property chiefly to the gum, mucilage, starch, oil, fat, glycerin, gelatin, or sugar which they contain, and, except in the case of oil and fat, to the solution of these substances in water.

Lenitives may be divided into Diluents, Emollients, and Demulcents.

Diluents comprise pure water and all aqueous solutions whose virtues chiefly depend upon this element.

Emollients are articles which tend to protect or to soften the skin.

Demulcents are agents intended to exercise a like influence upon the mucous membranes.

Emollients and Demulcents may be divided into four groups, the Mucilaginous, the Amylaceous, the Oleaginous, the Gelatinous, and the Saccharine. Each of these possesses qualities in some degree peculiar to itself, which will be pointed out in connection with the individual articles of the several groups. In this place we shall endeavor to describe the properties and uses of Lenitives as a class.

MODUS OPERANDI OF LENITIVES.

It seems not inappropriate to commence the study of the Materia Medica by examining a class of agents which are rather negative than positive in their medicinal operation, and which interpose themselves between morbific causes and the living organs rather than modify the latter, when diseased, by the exercise of any active virtues.

In all idiopathic fevers, an examination of the blood and of the secretions shows that there is retained within the system an undue proportion of effete elements, which, in health, are discharged through the kidneys, the skin, and other emunctories, and it is probable that these elements not only interfere with the organic changes which belong to the healthy nutritive process, but act directly as irritants to the nerves, producing the numerous distressing sensations which accompany the diseases in question. By

diluting the circulating fluid such symptoms are palliated, and the exhaustion which would result from their continuance is in some degree prevented. The same remarks apply to inflammatory affections, so far as in these the system at large sympathizes with the local disorder.

What is here presumed to be true of the operation of diluent lenitives upon the whole body in fevers, is more evident in regard to emollient and demulcent lenitives in the treatment of inflammatory diseases. Every local inflammation is aggravated, and in a great degree sustained, by its exposure to the action of external agents, among which not the least irritating are light and atmospheric air. For as these elements, in the normal condition of the external organs, supply a stimulus which is essential to their proper development and nutrition, so, when the same organs have their activity abnormally excited, the continuance of the habitual stimulus adds fuel to the fire, and may urge the inflammatory process into disorganization. The simple exclusion of the irritant, on the other hand, may suffice to dissipate all suffering, and reduce the action of the inflamed part within the limits of a quick and easy cure. In burns of the first degree, the application of a mucilaginous, amylaceous, oily, or gelatinous substance is sufficient to produce this effect. But the variety of remedies which are thus equally successful, proves that none of them exert a specific virtue, and the equal success of cotton-wool or powdered starch or flour confirms this conclusion.

But it does not follow that the application of a dry substance which excludes the air will be equally soothing with a moist one. Experience shows that, except in very superficial inflammations, the former is less efficient than a protective substance which is also moist. By the imbibition of the liquid the inflamed parts become relaxed, and the pain, in so far as it depends on their tension, is relieved. This operation is greatly facilitated if, under certain circumstances, the moist application is also warm. Gentle warmth palliates almost every form of pain except that which is seated in the head. Hence the union of a lenitive emollient with moisture and warmth, in the shape of a cataplasm, has in all ages been a favorite remedy, and continues every day to render its unpretending services with signal efficacy.

There is no inflammation of the chest or abdomen, or of the deep-seated parts of the extremities, which this homely application does not relieve. Whether it operates through the conducting power of the tissues intervening between itself and the seat of pain, or whether, as appears more probable, it acts by means of an impression upon the nerves, its soothing influence is as certain, and often as prompt, as the action of cold upon the surface of the body is in producing the inflammation of the organs beneath for which this remedy is employed. Care should be taken to keep all such applications in close contact with the skin, for otherwise they grow cold and become more hurtful than useful. Nor should they, when composed of bread and milk, or linseed meal, etc., be too long ap-

plied, lest they unduly soften the skin, or irritate it even to the production of pustules. It has been proposed to substitute water contained in *spongio-piline*, lint, or other porous tissue for the emollient poultices in common use; but these fabrics are more appropriate when cold and moisture are to be applied, as will be explained in its proper place. All of the substances referred to are constantly used as vehicles for the exhibition of stimulant, sedative, anodyne, and other medicines.

They also protect the parts to which they are applied from the action of irritating discharges, and are habitually employed for this purpose in the neighborhood of the various natural orifices of the body, and of wounds from which an acrid secretion flows. But on account of their greater permanence, as well as their inferior miscibility with the secreted liquids, fatty substances are to be preferred.

The action last referred to is one of the most important of those exerted by lenitives which are administered internally. From the anatomical relations of the intestinal mucous membrane, all irritating agents are more apt to exert a prolonged action upon it than they do when applied to the skin. These agents are numerous, and consist of ingesta which are either intrinsically irritant, or which become so during the changes which they undergo in the stomach and bowels; or else of the more or less altered secretions of the intestinal mucous membrane, or of the glands which pour their products upon it, and particularly of the liver, and perhaps, also, of the pancreas. When the sensibility of the mucous membrane is increased by inflammation, or otherwise, the secretions operate as irritants, and prolong and aggravate the disease. In like manner many acrid poisons are fatal from their concentrated form and the exposed state of the gastric mucous membrane. But lenitive medicines prevent or mitigate their effects, both by diluting the acrid agents, and by coating the mucous membrane with a protecting film. For this purpose, oily or albuminous substances are to be preferred in the case of irritant poisons, and mucilaginous substances when the stomach is otherwise inflamed. They do not appear to undergo changes in the stomach to the same extent as preparations chiefly composed of starch. The latter ought, however, under the circumstances supposed, to constitute the chief, if not the exclusive, food of the patient. A great advantage is their neutral taste, which enables them to be taken with less repugnance than articles which possess a definite savor. According to the peculiarities of the patient, a flavor may be given by the addition of saccharine or other more sapid substances without impairing their principal qualities. The action of lenitive medicines is well seen in their use as enemata, when the rectum is the seat of tenesmus produced by hemorrhoids, the inflammation of dysentery, etc. They often soothe the pain and calm the spasm, even when used alone, but they serve as convenient vehicles for other remedies of a more positive and active character.

But the continued use of this class of medicines is not unobjec-

tionable. If they are employed after the morbid sensibility of the digestive organs has subsided, they tend to impair the power of the latter in performing even their natural functions, and to reduce them to a state of atony which may lay the foundation of serious disease. This condition is not unfrequently observed in acute diseases affecting other organs than those of the abdomen, when nutritious food having been too long withheld, amylaceous and mucilaginous articles undergo decomposition in the alimentary canal, distending it with flatus and causing heart-burn and acid eructations. One reason, doubtless, of this occurrence is, that the liver and other glands appropriated to the function of digestion no longer secrete in sufficient quantities the fluids which are essential to its due performance, and, instead of being converted into chyle, or preserved unchanged for expulsion from the body, the substances in question undergo fermentative decomposition as they would elsewhere under the influence of heat and moisture, distending the bowels with flatus, and sometimes occasioning diarrhœa.

Medicines of the lenitive class may in other ways derange the stomach and bowels. Except in small quantities at a time, they generally produce, when given alone, an unpleasant impression upon the palate, and even some degree of nausea, and, indeed, if copiously administered, are apt to occasion both vomiting and a relaxation of the bowels. These effects are sometimes induced with a curative intention, particularly when the irritability of the gastro-intestinal surface is such that medicines of the emetic and cathartic classes would be inadmissible. Preparations containing mucilage or starch are most frequently employed for this purpose, but the fatty oils have a similar effect when given in large doses. It is undoubtedly by their bulk, in part, that such substances produce alvine evacuations, for they distend the bowel, and in this manner excite its peristaltic movements; but, being also relatively indigestible, they act as moderate irritants and provoke their own expulsion by stool. This is the case even with the simplest and mildest of all ingesta. A copious draught of cold water taken upon an empty stomach, is one of the very best means of procuring an alvine evacuation when torpor of the bowels depends upon their mere debility.

Of the substances belonging to the present class, certain of the constituents, viz., water, fat, albumen, and, perhaps, gum, are supposed to be absorbed from the alimentary canal, without any change of composition; but sugar is converted into lactic acid, and starch into the latter and grape sugar. But as none of these substances appear unchanged, or during health, in the secretions, it is evident that they must be employed for the purposes of the economy. Nitrogenous substances (fibrin, albumen, casein, gluten) become incorporated with the organs, and are ultimately excreted in the bile or urine. Carbonaceous matters (fat, gelatin, sugar, gum, starch) are supposed to serve less as nutriment for the repair of wasted tissue, in general, than as sustainers of animal heat by means of their combustion with the oxygen absorbed during respiration. Hence these substances have

been called *respiratory* by Liebig, and it is from them that the fat is derived, and held as a great reserve of carbonaceous matter in the system. None of them, however, possess the power of nourishing the body when given alone, and this is equally true of albumen and fibrin; while, on the other hand, a combination of saccharine, oily, and nitrogenous substances with water, such as naturally exists in milk, affords the most perfect nutriment for the animal frame, especially during the earlier periods of its development. But, in proportion as the waste of the system is augmented by laborious exercise, as in adult life, the more highly nitrogenized forms of food are required to maintain the strength. If, when the habit of employing them is confirmed, the diet is changed to amylaceous substances, immediately the strength declines, and the tone of the digestive system is profoundly impaired; the muscles become flabby and feeble, the skin pale, the bloodvessels less prominent, and the arterial pulsation weaker. Hence when, in the course of inflammatory affections, the activity of the circulatory system is morbidly increased, the use of lenitive medicines is an important element of the cure.

The last remark refers particularly to all those preparations of which water forms a large proportion, and also to water itself, as has already been pointed out. The symptom, thirst, which accompanies febrile affections, and sometimes reaches an intense degree, is a sufficient indication for the use of diluents, which, under the circumstances, are always preferred at a low temperature. In this way they not only dilute the blood and the secretions, and promote the latter, but actually cool the circulating fluids, assuaging the burning torments of fever and calming the excitement of the nervous system. In those cases of a different class, in which the action of the organs and the molecular changes of the tissues are impeded by the spissitude of the blood, the administration of diluent drinks is followed by a sense of inexpressible relief. This is often witnessed after profuse hemorrhage, and during the exhausting serous discharges which characterize epidemic cholera.

Diluent lenitives are the appropriate adjuvants of all diuretic medicines, and, indeed, without them, the latter will seldom operate efficiently. In order to promote their absorption from the intestine, it should first be thoroughly emptied of its contents, by a cathartic, which, besides removing a physical impediment, probably renders absorption more active by a stimulant impression upon the mucous membrane. Although proof is wanting that emollient substances communicate their peculiar properties to the urine, independently of the water in which they are administered, there is, at least, a general belief that they do so, and one which few persons are willing to disregard in practice. The direct connection of the urinary bladder with the sexual organs in the male, and its close apposition and sympathy with them in the female, often render the remedies in question very beneficial in the treatment of inflammation and irritation of the organs of generation. When the menstrual function is deranged by congestive affections

of the uterus and ovaries, emollient and diluent remedies, both internally and locally, are frequently of signal service; and they are even more palpably so in urethral inflammations affecting the male.

MUCILAGINOUS LENITIVES.

ACACIA.—Gum Arabic.

Description.—Gum Arabic is a gummy exudation from *Acacia vera*, and other species of *Acacia*, a thorny shrub, or small tree which abounds in Northern Africa and in Arabia. The gum exudes spontaneously from the trunk and branches, and hardens on exposure to the air. The finer qualities, which are imported from Turkey, occur in rounded, pale yellowish lumps, or *tears*, transparent but traversed by fissures, brittle, inodorous, and of a slightly sweetish taste. Its powder is opaque and white. It is soluble in cold and in hot water, but not in alcohol, ether, or the oils. Its solution has an acid reaction, and gives a precipitate with a solution of the subacetate of lead. The proximate composition of gum Arabic is represented by soluble gum about 80, water 17, and various salts 3; it is ultimately resolvable into carbon 42, hydrogen 7, oxygen 51.

History.—Acacia is spoken of in the Hippocratic writings as an African or Egyptian tree, and Strabo mentions an acacia hedge surrounding the temple of Osiris, at Acanthus, in Egypt, whither the gum was brought. A similar hedge existed at Abydos, and was dedicated to Apollo. The leaves, flowers, and fruit were all used as astringent medicines, and even the gum is mentioned as a remedy for uterine hemorrhage.[1] Pliny in like manner speaks of the astringency of the plant, of its being used for tanning, and of the astringent and sedative properties of the gum, which, he says, is employed in affections of the eyes, for dyeing the hair, curing erysipelas, ulcers, contusions, prolapsus of the uterus and rectum, etc. etc.; in a word, it is treated of as an active astringent.[2] In this account Pliny follows Dioscorides[3] and Theophrastus.[4] It is impossible that these descriptions, and others corresponding to them by certain of the Arabian authors, should have reference to gum Arabic. As Matthiolus long ago said, "it is easy to perceive that gum Arabic is a very different thing from gum acacia." Of the accounts furnished by the Arabian authors, almost the only one that appears to have reference to that which we call gum Arabic, is given by Hobaisch, who says: "It restrains ordinary diarrhœas, and furnishes a coating to the ulcerated bowel; it may be used to

[1] Dierbach, Arzneim. des Hippokrates, p. 65.
[2] Hist. Nat., lib. xxiv. cap. lxvii.
[3] Lib. i. cap. cxv. [4] Lib. iv. cap. iii.

retain broken bones in apposition; it allays coughing when it is held and allowed to dissolve in the mouth, and may be associated with other medicines which have the same effect; it is useful in pulmonary inflammations and catarrhs, and in inflammations of the eyes; it may also be associated with purgative medicines to temper their acrimony."[1]

Action and Uses.—Gum Arabic has generally been looked upon as a nutritious article of diet, and travellers have asserted that the Arabs in crossing the desert are in the habit of subsisting chiefly, if not exclusively upon it. It is probable that the proportion of it which enters into their sustenance has been exaggerated, for the experiments of Magendie show that dogs fed exclusively upon this substance lose flesh rapidly and at last perish in a state of marasmus. Boussingault fed a duck with fifty grammes of gum Arabic, and recovered forty-six from the excrements; and Frerichs, Blondlot, and Lehmann found that neither the saliva nor the gastric juice exercises any digestive action upon it.[2] The accurate researches of Dr. Hammond also led him to conclude that "gum, so far from having any value as an alimentary substance, is positively injurious, owing to the fact of its clogging the intestines, and thus proving a cause of irritation. As an article of food for the sick, its use should be especially condemned."[3] These experiments are exceedingly interesting, but they do not prove that gum when mixed with other food may not undergo changes which render it nutritive, nor should the experience of its utility in the treatment of inflammations of the stomach and bowels be lightly set aside by conclusions drawn from physiological experiments, however ingenious or however honestly performed. The loss of flesh, and strength, the craving hunger, and the feverishness induced in a robust man by an exclusive diet of gum-water, are not sufficient reasons for rejecting it as the food of one who is already enfeebled by fever, and is utterly without desire for food.

As a medicine, gum Arabic has sometimes been used in powder to arrest bleeding from leech-bites, from the gums, etc., which it does by favoring coagulation, but it is chiefly employed to protect mucous membranes from irritation. When the *fauces* are dry, and therefore irritable, especially at the commencement of the chronic and intractable affection known as *follicular pharyngitis*, a piece of the gum allowed to melt in the mouth excites the secretion of saliva, and, becoming dissolved in this fluid, forms a protective coating, and prevents the unpleasant sensation of dryness and the tickling cough which it induces. In *gastro-intestinal irritation*, and still more in inflammation of the bowels, its solution is more soothing to the affected membrane than water alone, and is probably more permanent in its influence. Combined with sugar in the form of a syrup, flavored with orange-flower water, and properly

[1] Ebn Baithar, ed. Sontheimer, ii. 133.
[2] W. A. Hammond, Prize Essay, Trans. Am. Med. Ass., x. 575.
[3] Ibid., p. 584.

diluted, it is an agreeable and useful medicine or drink, in cases of slight bronchial inflammation.

Administration. — An officinal solution, *Mucilage of Gum Arabic* (MUCILAGO ACACIÆ), contains in each fluidounce half an ounce of the gum, and is generally prescribed in the proportion of one part to twelve in a mixture or emulsion. *Syrup of Gum Arabic* (SYRUPUS ACACIÆ) prepared with gum, sugar, and water, is convenient for addition to mixtures, and may also, as above stated, be used when diluted with water, as a drink. Gum Arabic is used as the basis of nearly all the so-called pectoral gums and lozenges.

ALTHÆA.—MARSHMALLOW.

Description.—*Althæa officinalis* is an herbaceous perennial plant, several feet in height, with heart-shaped or ovate, downy leaves, and a long tap-shaped, and fleshy root. It grows in moist and marshy places in Europe and in this country, but in the former is extensively cultivated for medicinal purposes. In Europe the root, flowers, and leaves of *Malva sylvestris*, *Malva rotundifolia*, and *Althæa rosa*, as well as of Althæa officinalis, are employed in medicine. Their qualities are not materially different. As found in commerce, marshmallow root is in fragments several inches in length, deprived of their epidermis, round or in split pieces, whitish, light, and brittle. When chewed it has a mucilaginous and sweetish taste. Its chief constituents are mucilage and starch, making about 73 per cent. of the whole; it also yields some sugar, phosphate of lime, and fatty oil. Cold water extracts its mucilage, but hot water its starch also. Besides these elements it contains a proximate principle called *althein*, which is crystallizable, inodorous, almost tasteless, and is soluble in water and diluted alcohol.

History.—Nothing can illustrate more perfectly the carelessness with which singular qualities are sometimes applied to medicinal substances, than the history of this simple plant. Its very name, according to Dioscorides, was given it in consequence of its numerous virtues, because it is resolvent and maturative, brings abscesses to a head, and cicatrizes them when voided. Its root, boiled in water or wine, was applied as a pessary in uterine inflammations, and its decoction as an injection to promote the discharge of the placenta. Its juice, with wine, was esteemed diuretic, and useful in dysentery; with vinegar, it was a remedy for toothache; oil in which its seeds had been cooked was a terror to serpents, and good for dysentery, diarrhœa, spitting of blood, etc. etc.[1] Pliny, after enumerating these and similar statements, says: "Other marvels are told of mallows; but the greatest of all is that whoever will daily drink half a cupful of its juice will be exempt from all diseases." Still more marvellous is that which he himself declares to be ascertained, that the delivery of women in labor is hastened

[1] Lib. iii. cap. cxlvi.

by mallow leaves strewn under the bed; he adds that they must be removed immediately after the delivery, for fear that the uterus should also be expelled. He also avers, on the authority of Xenocrates, that the seeds of a species of mallow in contact with the genital organs of women infinitely excite their venereal desires, and that three roots applied to the same part have a similar effect! With more truth he states that injections of mallow tea are very serviceable in tenesmus and dysentery, and that taken internally it relieves dysury.[1]

Action and Uses.—Marshmallow decoction is an emollient protective, and somewhat nutritious, but when long and abundantly used it impairs the digestion. It is employed as a demulcent in all inflammatory and irritable conditions of the mucous membrane of the respiratory, digestive, and urinary organs, and poultices formed of the bruised or powdered root may be applied to local inflammations affecting the skin. The decoction has been used as an injection in dysentery and in inflammation of the uterus and vagina, and also to lessen rigidity of the soft parts in cases of difficult labor.

A preparation sold as *Marshmallow paste* is a very agreeable demulcent, but contains no marshmallow at all. It is made of gum Arabic, sugar, and white of eggs, and is flavored with orange-flower water.

CETRARIA.—Iceland Moss.

Description.—Cetraria, or *Iceland Moss* (*Cetraria Islandica*), is a cryptogamous plant of the natural order of lichens, which grows in rocky and mountainous situations, and most abundantly in the Alpine regions and northern countries of Europe and America. Its name is derived from the resemblance which its membranaceous and lobed frond or leaf bears to an ancient leather shield (καίτρεα). As found in commerce, cetraria consists of dry, leathery, crumpled leaves, which are of a brownish color, with occasional red spots upon the upper surface, and paler with whitish spots beneath. It is without odor, and has a bitter mucilaginous taste.

Cetraria imparts its virtues to boiling water, but by prolonged boiling its bitterness is impaired, and it loses its peculiar medicinal virtues. Its chief components are: 1. Amylaceous matter (*lichen-starch*, and *inulin*), 44 per cent. Of these two constituents, the former gives a blue, and the latter a yellow color, with iodine. Lichen-starch differs from ordinary amylaceous matter in not being contained within separate cells or granules. It is extracted by boiling water, and, on cooling, acquires the consistence of a jelly. 2. *Cetrarin*, a bitter principle, 3 per cent. It is an acid, and may be removed from the plant by macerating it in a weak solution of carbonate of soda. The Icelanders, in preparing lichen for food, grind it into a coarse powder, and then by repeated washings

[1] Lib. xx. cap. lxxxiv.

deprive it of the greater part of its bitterness. Besides these constituents, lichen contains amylaceous fibrin 36.2 per cent., gum, sugar, yellow extractive, bitartrate of potash, tartrate and a trace of phosphate of lime, and a trace also of gallic acid.

History.—Iceland moss was brought into notice by Olaf Borrichius in 1674, and by Hjarne in 1683, as a medicine used by the inhabitants of Iceland in scurvy, hæmoptysis, and pulmonary disease with purulent expectoration, and also as an aliment in times of famine when deprived of its bitterness by being cut into small pieces and steeped in water. Many physicians vaunted its qualities as so admirable that, near the close of the last century, Murray could say of it "inter præstantissima igitur hodie medicamina splendet."[1] This general confidence in its virtues is ascribed to the influence of Scopoli, an Austro-Italian physician, who died in 1788.

Action.—Iceland moss is mildly tonic, demulcent, and nutritious. The first named quality it owes exclusively to cetrarin, and the others to starch. The cetrarin is extracted by infusion as well as by decoction, but the starch by decoction only. The infusion on this account exhibits the action of a bitter tonic. It has a very bitter taste, increases the appetite, promotes digestion, and thus indirectly favors nutrition. It manifests no stimulant action upon the circulation, and does not occasion constipation of the bowels. Like other bitter tonics, in large doses, on the contrary, it causes diarrhœa, nausea, and oppression at the stomach. Deprived of its bitter principle, it does not differ materially in its action from other amylaceous preparations. It is said that the milk of nursing women becomes bitter when they make use of the infusion.

Uses.—Iceland moss was first used as a medicine by the Icelanders and Greenlanders in chronic pulmonary complaints. Linnæus also gave it the preference over all other substances of its class as an article of food for the consumptive; but Scopoli first brought it into general notice as a remedy for phthisis, which was then understood to include various forms of chronic bronchitis as well as tubercular consumption. In chronic bronchial affections with copious purulent or mucous expectoration, it was highly commended by Stoll. It was reputed to moderate the cough, render the breathing freer, appease the fever, correct the qualities of the sputa, increase the appetite, restore the digestive function, augment the muscular strength, repress colliquative perspiration and diarrhœa, and improve the nutrition, substituting fulness of flesh for emaciation. It was expressly stated to be useless, but not injurious in tuberculous phthisis.[2] So Reece, admitting the same distinction, says, the dietetic properties of lichen residing in a jelly or mucilage, it affords support to the debilitated frame of a phthisical patient; while the bitter principle, to a certain extent, is evidently of an anodyne or composing nature, allaying cough, and, unlike opium, at the same time facilitating expectoration, abating hectic fever, and quieting the whole system, without constipating the bowels.

[1] Apparat. Med., v. 499. [2] Paulisky, Appar. Med., v. 514.

The bitter quality likewise possesses a peculiar tonic power, etc.[1] More recently, M. Clertan, of Dijon, states, that the absence of fever and pain are necessary conditions for the administration of this medicine, and that the cases in which it is most successful are those in which coughing is constantly provoked by a tickling in the trachea, and the sputa are viscid and transparent.[2]

Decoctions of Iceland moss have been used in chronic affections of the *bowels*, particularly in those depending upon mere relaxation of the mucous membrane, and sometimes also in chronic dysentery without symptoms of active inflammation.

Administration.—If the tonic rather than the demulcent operation of the medicine is desired, an infusion of it is preferable to a decoction; but usually the combination of virtues obtained by moderate boiling is more desirable. The officinal decoction (Decoctum Cetrariæ) is prepared by boiling half a troyounce of Iceland moss in a sufficient quantity of water for fifteen minutes, straining with compression, and adding sufficient water through the strainer, to make the decoction measure a pint. This quantity may be taken in the course of twenty-four hours. In order to mitigate its bitterness, it may be sweetened with honey or sugar. An infusion may be likewise prepared by steeping three ounces of the bruised plant in a pint and a half of boiling water for three hours, evaporating the liquor with gentle heat to the consumption of one-half, and adding sixty grains of extract of liquorice. Of this, three tablespoonfuls may be taken every three or four hours. It has sometimes been given in decoction with milk, which in some degree conceals its bitterness. This quality may be diminished, or, indeed, entirely removed, by macerating the lichen in an alkaline solution containing one part of caustic potash to three hundred parts of water, and then washing it with cold water.

CHONDRUS.—Irish Moss.

Description.—Carrageen, or Irish moss, consists of the flat, slender, cartilaginous frond of *Chondrus crispus*, a plant of the natural family *Algæ*, which grows upon the western coast of Ireland, England, and the continent of Europe. When fresh, it is of a purplish color, which fades in drying, until it becomes yellowish or dirty white, except in small portions. It is tough, and, as it were, cartilaginous or horny, partially translucent, has a marine odor, and but little taste. It dissolves in boiling water, forming, when cold, a clear and colorless jelly, which is not unpleasant to the taste. It contains, according to Herberger, pectin, 79.1; mucus, 9.5; resin, 0.7; with fatty matter, free acids, phosphorus, alkaline earths, etc. Iodine, and, also, bromine, have been detected in carrageen. According to Herberger, the pectin of this plant, which

[1] A Treatise, etc., 2d ed., p. 3.
[2] Bull. de Thérap., xliii. 182.

Berzelius denominates *carragine*, is peculiar; differing from animal mucus on the one hand, and from vegetable mucus on the other.

History.—Carrageen has from time immemorial been used as food and medicine by the inhabitants of the west of Ireland. According to Pereira, it was introduced into medicine by Mr. Todhunter, of Dublin, in 1830. On the continent, attention was first drawn to it by Von Gräfe, in 1833.

Action and Uses.—Carrageen resembles Iceland moss deprived of its bitter principle. It is simply nutritious and demulcent; yet it has had an extensive reputation for efficiency in curing chronic pulmonary affections attended with discharges and cough; chronic intestinal fluxes; chronic affections of the urinary passages, etc. But there is no proof that it possesses any peculiar efficacy in these disorders.

A preparation which is highly nutritious, and has an agreeable odor and taste, may be made, according to the directions of Dr. Frank, thus: Take of Irish moss, macerated and washed, gr. xxx; spring water ℥xvj; boil down to one-half, strain with expression, and add to the strained liquor, white sugar ℥iv; gum Arabic, powdered, ℥j; and powdered orris root gr. xxx; heat to dryness with a gentle temperature, stirring constantly so as to obtain a pulverulent mass, to which three ounces of arrowroot are to be added by trituration. A jelly is prepared with this powder, by rubbing a teaspoonful of it with a little cold water, and then pouring a cupful of boiling water on it. (*Neligan.*)

LINUM.—Flaxseed.

Lini Farina.—*Flaxseed Meal.*

Description.—Flaxseed is produced by *Linum usitatissimum*, or common flax, which seems to have been cultivated first in Egypt, and is so now in every part of the world. It is an annual plant, with a slender root, smooth, erect stem, about a foot and a half high, and branched at the top. The leaves are alternate, lanceolate, and smooth, and the flowers blue and arranged in terminal corymbose panicles. The seed-pod is roundish, about the size of a pea, and contains ten seeds in distinct cells. The seeds are brownish and shining without, whitish within, about a line in length, and of a flattened oval shape. They have no smell, but an unpleasant, sweetish, oily, and mucilaginous taste. The husk contains an acrid soft resin, and the nucleus fatty oil, gum, mucilage, starch, albumen, gluten, etc. The mucilage is readily extracted by hot water, one part of the unbruised seeds rendering sixteen parts of boiling water mucilaginous. The oil is procured by expression. The ground seeds are known as *flaxseed meal.*

History.—Flax was known to the ancient Egyptians.[1] Hippo-

[1] Exodus ix. 31.

crates recommends flaxseed with the yolk of an egg in children's catarrh, in abdominal pains, diarrhœa, dysmenorrhœa, and leucorrhœa. He prescribes flaxseed cataplasms to be applied to the chest in inflammations of this region, and is careful to observe that the application must be warm, or else that it will chill the patient. He more especially speaks of them as emollient remedies for inflamed and indurated parts.[1] Pliny furnishes a detailed account of the economical uses of flax, among which, having mentioned the manufacture of ropes and sails which carry men to perish at sea without the rites of burial, he exclaims: "No execration is strong enough against the inventor of such things."[2] Elsewhere he enumerates its medicinal qualities, as emollient, maturative, cleansing, soothing, and healing.[3] In this account, which he copies from Dioscorides, mention is also made of the frequent use of flaxseed to prepare enemata and vaginal injections. Arabian writers add very little of their own, but one, speaking of flaxseed enemata in dysentery, says that they are most efficient when prepared with oil.[4]

Action and Uses.—The union of oil and mucilage in flaxseed renders it peculiarly adapted for many external applications in which an emollient is required, and the facility with which its infusion is absorbed from the stomach has led to its being universally used to promote a diluent and diuretic action. In all inflammations whatever of the internal mucous membranes, flaxseed tea is habitually employed, but especially in those of the bronchia and urinary organs. In the former it serves as a vehicle for many mild expectorant remedies, and is the basis of numerous ptisans, containing ingredients like those of the compound decoction of barley. It also, as in ancient times, is a favorite form of enema, whether for the purpose of merely unloading the rectum of feces, or of soothing the irritation in this organ produced by dysentery, hemorrhoids, etc. For internal use, the *infusion* is generally made with half an ounce of the whole seeds to a pint of boiling water. It may be prescribed internally in any quantity. Externally it is often resorted to in cases of erysipelas, burns, etc., but it is apt to harden and render the skin very stiff and uncomfortable. In such cases acetate of lead is sometimes dissolved in it. The subacetate cannot be used in the same manner, as it undergoes precipitation.

The flaxseed poultice is the one most frequently employed in public, and perhaps, also, in private practice. It is prepared by pouring boiling water upon the meal, and stirring the mixture until it acquires a proper consistence. Before being applied to the skin, its surface should be slightly covered with sweet oil or other unctuous substance, or with glycerin, to prevent its adhering, and also to obviate the irritation which is otherwise apt to display itself in the form of a papular or pustular eruption. Flaxseed poultices have a greater tendency than others to render the skin white, wrinkled, and sodden.

[1] Dierbach, Arzneim. des Hipp., p. 73.
[2] His. Nat., lib. xix. cap. 1.
[3] His. Nat., lib. xx. cap. xcii.
[4] Ebn Baithar, i. 134.

SALEP.

Description.—Salep, which is not officinal in the Pharmacopœia of the United States, is the bulb of *Orchis mascula*, and other species of Orchis. It grows abundantly in Southern Europe, and is found even in England; but the Salep of commerce is chiefly brought from the Levant. Salep is in the form of rounded pieces, from the size of a cherry-stone to that of an almond, of a grayish-yellow color, semi-transparent, hard, and horny, and of a slightly hircine odor when fresh. It is exceedingly difficult to pulverize unless it is first softened by being soaked in water. Its taste is mucilaginous and slightly saline. Guibert, who analyzed the recent bulb, found it to consist chiefly of starch slightly soluble in boiling water, but swelling in it so as to form an abundant and tenacious jelly of mucilage and calcareous salts. C. Schmidt obtained similar results.

History.—This plant, or rather the genus to which it belongs, was called *orchis*, or cynos-orchis (dog's testicle) by the Greeks, on account of the shape of its bulbs. Dioscorides refers to the popular belief that if men eat the larger bulb it causes them to engender males, and that if women eat the smaller they conceive females; he likewise alludes to the notion that the former excites, while the latter restrains the venereal passion. He also mentions that cataplasms are made of the bulbs for ulcers, abscesses, etc., and that they are very nutritious as food.[1] The same author describes very correctly the peculiar apposition of the bulbs, when he says they lie together like two olives, of which the one is full and succulent, but the other dry and wrinkled. In truth, as is now well known, the former is the new and growing bulb, but the latter the old and withered. Floyer calls this plant *Male Fools-Stones*, and says that the rank smell of the bulb shows some venereal virtue.[2] Culpepper, also, like Dioscorides, attributes contrary virtues to the two bulbs, adding, "these alter every year by course, when the one riseth and waxeth full, the other waxeth lank and perisheth."[3] The Arabian physicians prescribed salep with great confidence in consumption; the Indian practitioners believe it to be a powerful strengthener of the body; and by the Egyptians it is considered as a medicine possessing great invigorating virtues.[4]

Action and Uses.—Salep is demulcent and nutritious, and tends rather to confine than to relax the bowels. The notion of its possessing aphrodisiac virtues was evidently suggested by the arrangement of its bulbs and the absurd doctrine of signatures. Of amylaceous substances there is none superior to salep as food for those who are disposed to intestinal relaxation, and hence it forms one of the most useful articles of diet for infants and children affected with summer complaint or diarrhœa. In chronic dysenteric

[1] Mat. Med., lib. iii. cap. cxxiv.
[2] Touchstone, etc., p. 159.
[3] Herbal.
[4] Ainslie, Med. Ind., i. 368.

affections, and in the diarrhœa dependent upon tuberculous ulceration of the bowels, it is one of the best articles of diet that can be employed. The mucilage is prepared by first macerating powdered salep in cold water, and gradually adding boiling water, with stirring, in the proportion of five grains to the ounce of water. Or, instead of water, milk, or some animal broth may be used, and flavored or seasoned according to circumstances. Salep *jelly* is made as follows: Rub sixty grains of salep with water in a mortar until it has swollen to four times its original bulk, then add gradually, and with constant stirring, sixteen ounces of boiling water, and boil down to eight ounces.

SASSAFRAS MEDULLA.—Sassafras Pith.

Description.—The pith of the stem of *Sassafras officinale* is in whitish, semi-cylindrical pieces, very light and spongy, and of a somewhat camphoraceous taste. With cold water it forms a transparent, ropy mucilage, which has slight adhesive qualities, and is not, like mucilage of gum Arabic, rendered turbid by alcohol.

Action and Uses.—The mucilage of sassafras pith is demulcent, and at the same time a very mild local stimulant. It may be used for all the purposes, both internal and external, to which the mucilages are applied. It is most commonly employed as a collyrium, in acute conjunctivitis, either alone, or as a vehicle for other and more active remedies. It is equally appropriate as a soothing application in erythematous and other inflammations of the skin. Internally, this mucilage may be given freely as a drink in dysentery and other bowel complaints, and in febrile affections generally.

SESAMUM.—Benne.

Description.—*Sesamum Indicum* and *Sesamum orientale*, which are the officinal sources of Benne, are natives of India, but now abundant in all Asia, Egypt, and Italy. The first named species is said to be that which is cultivated in South Carolina (whither it was brought from Africa by the negroes), and also in the neighborhood of Philadelphia. Benne is an annual plant, four or five feet high, with a pubescent stem, ovate-lanceolate and lobed leaves, reddish-white axillary flowers, and an oblong capsule containing small, oval, yellowish seeds. The seeds furnish abundantly a fixed oil, and the leaves yield to cold water a large quantity of rich, bland mucilage, closely resembling that of sassafras pith.

History.—Sesame was anciently ranked among the most nutritious grains. Hippocrates recommended consumptive persons to use bread made of it instead of wheaten bread; and in pulmonary catarrhs he prescribed an emulsion made with sesame, almonds, and melon seeds. To this day sesame is employed to make bread throughout oriental countries, and even westward to the Levant. In Hindostan

the natives use the expressed oil of the seeds for the same purposes for which we employ olive oil, and also as a medicine. Ainslie says that it is considered by some native practitioners to possess emmenagogue virtues, and to be capable, if taken incautiously, of producing abortion.

Uses.—The seeds of sesame are used by the negroes of South Carolina in making broths, and are also eaten parched. The oil is more bland than olive oil, and may be applied to the same purposes. The mucilage is generally prepared from the fresh leaves by infusing them in cold water. It is much esteemed as a demulcent drink in cholera infantum, and other disorders of the bowels in children. Doubtless it is applicable to the same cases as other mucilages, both internally and externally, and in the former mode has the advantage of an agreeable taste.

TRAGACANTHA.—Tragacanth.

Description.—Tragacanth is the gummy exudation from *Astragalus verus* and of other species of Astragalus. The species named is a small prickly shrub, covered with pointed imbricated scales, which grows wild in many parts of Asia Minor. The gum exudes from the lower part of the stem through natural fissures in the bark, or through punctures made with a knife. In the former case it assumes the shape of tortuous vermicular filaments, and, in the other, of flatter pieces with concentric elevations.

Tragacanth is inodorous and insipid, very hard, and, owing to its strong attraction for water, difficult to pulverize unless thoroughly dried and pounded in a heated mortar. When added to water it does not readily dissolve, but forms a very tenacious paste, and, with a larger proportion of water, a very thick mucilage. According to Bucholz, it is composed of common gum (arabin) 57 per cent., and bassorin, or insoluble gum, 43 per cent.; but Guibourt maintains that tragacanth contains neither arabin nor bassorin, but is mainly composed of an organized gelatinous substance, which swells and divides in water, so as only partially to traverse a filter, and which greatly differs in its physical and chemical properties from gum Arabic. The portion which is insoluble even in boiling water is, according to the same authority, a mixture of starch and woody fibre.[1]

History.—Tragacanth was well known to the ancients. Dioscorides describes it as a concrete juice obtained by incisions made in the root of a tree, and says that it is associated with other medicines for the eyes, for cough, dryness of the throat, a cracked and hoarse voice, etc. He adds it is used for making electuaries or lozenges, which are allowed to dissolve in the mouth.[2] Galen gives a similar account, adding that it moderates the activity of heating or irritating medicines. The same remark is repeated by the Ara-

[1] Hist. des Drogues, 4ème éd., iii. 418. [2] Mat. Med., lib. iii. cap. xx.

bians, who insist upon its virtues in promoting expectoration and allaying irritation of the lungs, and recommend it as an emollient and soothing application to inflamed parts.[1]

Action and Uses.—Tragacanth is demulcent and nutritious, but, owing to the difficulty of dissolving it, is seldom used medicinally, except as a vehicle for substances that are not soluble in water, as camphor, and as an excipient in troches and lozenges, which are intended to dissolve slowly in the mouth. On account of its tenacity, the mucilage of tragacanth (MUCILAGO TRAGACANTHÆ) (℥j to boiling water Oj) has sometimes been used as a protective application to burns.

ULMUS.—SLIPPERY ELM BARK.

Description.—This is the inner bark of *Ulmus fulva*, the slippery or red elm, a tall native tree of North America, growing most abundantly west of the Allegheny Mountains. The outer bark is rough, brownish on the trunk and whitish on the limbs. The inner bark, as brought into commerce, is in long flat pieces, of a tawny color, folded on themselves, readily torn into long fibres, of a somewhat sweetish smell and taste, and very mucilaginous when chewed. It is also ground into a coarse light powder of a grayish-yellow color. It yields its mucilage abundantly to cold, and still more so to hot water, and precipitates the acetates of lead from their solutions. No sufficient analysis of this bark has been published.

Action and Uses.—Undoubtedly the principal action of slippery elm bark is due to its abundant mucilage, in virtue of which it is demulcent in a high degree. But that it contains another peculiar principle is shown by its power of preserving fatty substances from rancidity. This power was well known to the aborigines, who prepared bear's fat by heating it with the bark. Dr. Wright, of Cincinnati, found this method of preserving butter and lard successful.[2]

As a demulcent, the mucilage of slippery elm bark is constantly used in all acute affections of the respiratory, digestive, and urinary organs. It is grateful to the taste, and does not readily disorder the stomach. To some extent, also, it is nutritious. The American Indians employed it internally for the cure of some cutaneous diseases, and Dr. Griffith says that from witnessing its effects in some extremely obstinate cases of herpetic and syphilitic *eruptions* he was inclined to attribute to it higher curative powers than are usually admitted.[3] Dr. J. R. Dowler, of Illinois, has reported two cases which seem to demonstrate the efficacy of this bark as a remedy for *tapeworm*.[4] The inner bark of the European elm (*U. campestris*) has long been celebrated as a remedy in cutaneous diseases,[5]

[1] EBN BAITHAR, op. cit , ii. 350.
[2] U. S. Dispensatory.
[3] Med. Botany, p. 653.
[4] Bost. Med. and S. Journ., Mar. 1865, p. 132.
[5] Mem. Lond. Coll. Phys., ii. 193.

but besides mucilage, which it contains in less quantity than the American species, it has a bitter and astringent taste.

For external application, the mucilage and the powdered bark are in general and constant use. The former is frequently applied to erysipelatous and other acute eruptions of the skin, and the latter, as a poultice, to abscesses, inflamed joints, etc. An objection to both, however, is that they, and especially the former, harden upon the skin and render it stiff and uncomfortable. When poultices of slippery elm are used, they should be prevented from drying by being covered with oiled silk, gum elastic, gutta percha, or some other impermeable material.

In 1837, Dr. McDowell, of Virginia, proposed the use of slippery elm bark to dilate strictures of the urethra, fistulas, etc., but it was found that the liability of the bark to fracture rendered it an ineligible instrument. Dr. H. R. Storer, of Boston, acting upon the original suggestion, applied slippery elm bark to the manufacture of tents for dilating the neck of the uterus in cases of disease within that organ. By disintegrating the fibres, a mass of flexible, tough, spongy tissue was obtained, readily moulded into the shape of a tent, endowed with a less degree of expansibility than sponge, and on that account, according to Dr. S., more safe in the using. It is also free from the liability of producing an offensive smell, as sponge does, while the mucilage it yields acts favorably upon the distended parts.[1]

AMYLACEOUS LENITIVES.

AMYLUM.—Starch.

Description.—Starch is the fecula of the seed of *Triticum vulgare.* It is a proximate principle constituting a large portion of the vegetable food consumed by animals. It is prepared for medicinal purposes by washing coarsely-bruised wheat repeatedly with cold water, which dissolves out the starch, and then separating the latter by draining off the water. When dried and prepared for sale, starch is in irregular or columnar white masses, light, brittle, and readily pulverized. It dissolves in boiling water, and forms with it, on cooling, an opalescent semi-transparent jelly or thick liquid. It forms with iodine a blue compound, and is the most delicate and certain test of the presence of iodine in solution.

History.—Dioscorides[2] and Pliny[3] both describe a process for preparing starch, which is almost identical with that used at the present day; the former mentions it as a demulcent application to inflamed eyes, and to ulcers, and says that internally, it is useful

[1] Bost. Med. and Surg. Journ., Nov. 1855, p. 297.
[2] Lib. ii. cap. xciv. [3] Hist. Nat., lib. xviii. cap. xvii.

in hæmoptysis and dryness of the throat. He adds that it is made into porridge with milk, and is used in the culinary art. Both of the above authors derive amylum from *ἀ*, *priv.*, and *μύλη*, mill, because it is flour made without a mill.

Action and Uses.—Starch is used in solution as a demulcent to protect irritated surfaces, but chiefly as an emollient enema in dysentery, or to serve as a vehicle for narcotic or other substances into the economy. It is a convenient and useful excipient for vaginal injections. Bandages saturated with starch have been employed in the treatment of fractures as a substitute for splints. Powdered starch is extensively used to dust the skin of infants and delicate females, where it is exposed to attrition, or to absord the moisture which renders it liable to become irritated. Starch mixed with water is the best antidote to the caustic action of iodine upon the alimentary canal, as it forms a bland compound with this substance. Starchy food should be avoided in fermentative dyspepsia, especially when associated with ulcer of the stomach.

AVENÆ FARINA.—Oatmeal.

Description.—Oatmeal is prepared from the seeds of *Avena sativa.* According to Christison's analysis, it contains 72.8 per cent. of starch; 5.8 of saccharo-mucilaginous extract; 3.2 of albumen; and 11.3 of lignin of bran.

History.—Pliny says that the Germans used oatmeal porridge as food,[1] that, like barley and other grains, it is made into poultices, and that its decoction is good for a cough.[2] Dioscorides and Galen make similar statements, but the latter adds that although it is fitter food for beasts than men, yet in times of famine it is used by the latter. In modern times the Scotch peasantry, like the ancient Germans, depend upon it mainly for sustenance.

Action and Uses.—On chemical grounds, and from experience, oatmeal must be regarded as very nutritious, but when used as an exclusive diet for a length of time, it is apt to cause acidity of the stomach. The prevalence of pyrosis and gastrodynia among those who subsist upon it is well known.

In medicine it is chiefly used as a diet for the sick, made into a thin mixture with water (gruel), and is more nutritious than the purely amylaceous substances, as sago, arrowroot, etc. It is one of the best articles of food that can be taken by those who suffer from constipation depending upon inertia of the bowels produced by sedentary habits. Like all alimentary substances which contain an unassimilable element, oatmeal, when long used as an exclusive diet, is apt to leave its bran in the bowels, where, by gradual accumulations, it may form large concretions. Diuretic virtues have been ascribed to a decoction of oats made by boiling a double handful

[1] Lib. xviii. cap. xliv. [2] Lib. xxii. cap. lxxix.

of oats in three quarts of water for about a quarter of an hour. A teacupful of the strained decoction is given frequently.

Oatmeal gruel or *porridge* is prepared by boiling from one to two ounces of the meal with three pints of water to a quart, straining the decoction, allowing it to stand till it cools, and then pouring off the clean liquor from the sediment. Dr. A. T. Thomson gives the following directions for preparing *Flummery* or *Sowens:* "Take a quart or any quantity of groats, or of oatmeal; rub the groats or the meal for a considerable time with two quarts of hot water, and leave the mixture for several days at rest, in an earthen vessel, until it becomes sour; then add another quart of hot water, and strain through a hair sieve. Leave the strained fluid at rest until it deposits a white sediment, which is the starch of the oats; lastly, pour off the supernatant water, and wash the sediment with cold water. The washed sediment may be either boiled with fresh water, stirring the whole time it is boiling, until it forms a mucilage or jelly, or it may be dried, and afterwards prepared in the same manner as arrowroot mucilage. It may be eaten with milk or wine, or lemon-juice and sugar."

HORDEUM.—Barley.

Description.—Barley is the decorticated seed of *Hordeum distichon.* It has been found growing wild in both hemispheres. The cultivated plant is too well known to require description. According to Einhoff, barley contains about 67 per cent. of starch, besides sugar, gum, gluten, etc.; but Proust found in it 32 or 33 per cent. only of starch, and 57 or 58 per cent. of *hordein*, a substance which differs from starch in not forming a paste with hot water. Pearl barley is the seed deprived of its investment, by which means it is reduced to an almost pure starch.

History.—Barley is repeatedly mentioned in the books of the Old Testament, and first as among the things that were destroyed by the plagues of Egypt.[1] In the Hippocratic writings it is named more frequently than almost any other substance used in medicine. With its husk it was regarded as laxative, but when deprived of this investment, as tending to confine the bowels. It was used to make poultices, but chiefly to form ptisans; indeed we are assured that the word *ptisan* standing alone, always signified barley water. It was prepared so as to be used either with the barley in it, or deprived of this by straining through a sieve. It was held to be the best of all articles in febrile affections, both as food and drink, on account of its mucilaginous consistence, its digestibility, and its agreeable taste, and because it does not produce thirst or flatulence. Barley water with honey was constantly used in acute pulmonary affections.[2] Dioscorides says that barley is detergent, and, contrary to the statement of Hippocrates, that it is flatulent and injurious to

[1] Exodus ix. 31. [2] Dierbach, Arzneim. des Hippokrat., p. 9.

the stomach, but in the latter opinion he is also opposed to Galen. Dioscorides dilates upon the advantages of cataplasms made of barley meal and applied to abscesses, and other inflammations of external parts,[1] and Pliny describes in detail a number of such applications rendered more active by narcotic, stimulant, or astringent ingredients.[2] The Arabians add nothing to these accounts, except that they recommend barley water as a gargle in sore throat.[3]

Uses.—The simple decoction of barley water is the usual drink prescribed in all febrile affections, and particularly in those of the pulmonary, digestive, and urinary organs. It is more appropriate than rice water when there is no tendency to diarrhœa, and is presumed to have a more soothing action upon the inflamed or irritated mucous membrane. In bronchial affections it will be found useful to employ the compound rather than the simple decoction, or to use the latter sweetened with honey. The same preparation may be used as a gargle in a sore throat with or without the addition of lemon-juice or other acid, either vegetable or mineral.

For medicinal purposes barley is chiefly used in *decoction* (Decoctum Hordei), which is prepared by boiling, for a short time, two ounces of well-washed pearl barley in half a pint of water, which is then thrown away, and four pints of boiling water are added. The whole is boiled down to two pints and strained. If to the simple decoction, thus prepared, are added two ounces and a half of figs, five drachms of bruised liquorice root, two ounces and a half of stoned raisins, and a pint of water, and the mixture is boiled down to two pints and strained, we have a compound decoction of agreeable taste and useful qualities, as being both laxative and demulcent.

MARANTA.—Arrowroot.

Description.—Arrowroot is the fecula derived from the rhizome of *Maranta arundinacea* and other species of Maranta cultivated in the West Indies, and the extreme southern parts of the United States, the East Indies, the Mauritius, and Southern Africa, to which places it was transplanted from the West Indies. The most esteemed is brought from Bermuda. The rhizome is elongated, horizontal, articulated, fleshy, and white. Besides 65 per cent. of water, it yields 26 per cent. of starch, which is obtained by reducing the rhizome to a pulp, mixing it with water, passing it through a sieve to remove the impurities, draining off the water, and drying the fecula in the sun. As found in the shops, Bermuda arrowroot is a snow-white powder, intermixed with small, irregular masses of fecula, somewhat gritty under pressure, and of a sweetish taste as it dissolves in the mouth.

History.—"This plant was brought from the island of Dominica

[1] Mat. Med., lib. ii. cap. lxxix.
[2] Hist. Nat., lib. xxii. cap. lxviii.
[3] Ebn Baithar, ii. 97.

by Colonel James Walker, to Barbadoes, and there planted. From thence it was sent to Jamaica. That gentleman observed that the native Indians used the root against the poison of their arrows by mashing and applying it to the poisoned wounds. The valuable properties of the starch made from the root are mentioned by Hughes in 1751, and the mode of preparing it described by Browne in 1789." (*Pereira.*)

Action and Uses.—As the purest natural form of starch, arrowroot is nutritious and demulcent. It is entirely devoid of irritant properties, in which respect it differs materially from potato starch, which is frequently sold under its name. On this account it constitutes a very excellent article of diet for the sick in all febrile affections, and especially in disorders of the stomach and bowels. It is superior to all other articles of the amylaceous class as food for infants at weaning, or when milk alone proves indigestible. It is prepared by mixing a tablespoonful of arrowroot with a little cold water until it is reduced to a paste, and then gradually adding a pint of boiling water or milk, or due proportions of each, stirring the mixture at the same time. It may then be sweetened. Cream is sometimes added to the watery solution in cases of irritability of the stomach or bowels. In low forms of disease a little wine or spices may also be used with the watery preparation of arrowroot.

Other varieties of fecula resembling the above are used medicinally. The purest of these is *Tous-les mois*, obtained from a tuberous root of the West Indies (*Canna coccinea*, Guibourt). Purified *potato starch* answers for ordinary purposes as food, but, as remarked, not when the stomach and bowels are irritable.

ORYZA.—Rice.

Description.—The fruit of *Oryza sativa*, a native plant of the East Indies, but now cultivated in many parts of the western world, and especially in the United States and in Italy. It contains about 85 per cent. of starch, and nearly 4 per cent. of gluten, and cannot be considered as nutritious as wheat.

History.—Rice was known to Celsus, Pliny, Dioscorides, and Galen, who all agree in ascribing to it nutritive qualities, and in stating that it tends to confine the bowels, and hence is appropriate in relaxation of these parts. The Arabians speak of the peculiar efficacy of rice-water in colic and dysentery, when given by the mouth, and also as an enema. They further allude to its universal use by the Orientals as food.

Uses.—Rice, it is well known, forms the almost exclusive food of millions of the human race, yet it has been doubted whether it is fitted of itself to sustain life! When properly boiled it forms an excellent diet for the sick, and its decoction, or rice-water, is peculiarly adapted to affections accompanied with looseness of the

bowels. Rice water is made by boiling two ounces of rice in two quarts of water, for an hour and a half, sweetening and flavoring it according to circumstances.

SAGO.

Description.—Sago is the prepared fecula of *Sagus Rumphii*, and other species of Sagus, growing in the East Indies, and especially in the islands of the Indian Archipelago. It is obtained by mixing with water finely-broken pieces of the stem of the tree, by which the fecula is extracted. It is then separated by straining from the woody fragments, and the water is evaporated, leaving the fecula behind. It is afterwards prepared with much skill, and brought into commerce in the form of small, whitish or pinkish spherical grains, which become transparent in hot water, and ultimately, although not readily, dissolve in it. Sago is probably composed almost entirely of starch, but we are not acquainted with any analysis of it.

History.—The earliest account of sago was given by Marco Polo in the thirteenth century, but it was more accurately described by Clusius in the sixteenth. Granulated sago was first taken to Europe in 1729.[1]

Uses.—Sago is demulcent and nutritious, and is admirably adapted to be used as food for the sick whenever the digestive organs are feeble, or the existence of fever calls for nourishment without stimulus. It is generally more acceptable to the palate than arrowroot or tapioca, and is more digestible than rice.

TAPIOCA.

Description.—Tapioca is the fecula of the root of *Jatropha Manihot*, or cassava, a native shrub of the West Indies and Brazil, although Raynal states that it was originally brought from Africa by the negroes.[2] The root is a large tuber abounding in a milky juice. It is reduced to a pulp and subjected to pressure, dried and ground, and its volatile and poisonous part having been dissipated by heat, it is used to make bread, puddings, etc. The expressed juice contains a large proportion of fecula, which subsides on standing, and then, after having been well washed with water, is dried in the sun or by artificial heat, and forms the tapioca of commerce.

Tapioca consists of rough, irregular, whitish masses, from the size of a grain of mustard seed to that of a cherry-stone. It is hard and tough, has but little taste, is slightly soluble in cold water, and forms with boiling water a transparent, viscid, and tremulous jelly. When the starch is dried without heat, it constitutes the *cassava*

[1] STRUMPF, Handbuch, i. 39.

[2] Dict. de Mat. Méd., iii. 677.

starch or *Brazilian arrowroot* of commerce. It closely resembles genuine arrowroot in external appearance.

Tapioca, it has been stated, is associated, in the root of the plant from which it is derived, with a poisonous juice. The noxious principle is extremely volatile, and is dissipated by heat, or even by the exposure of the juice to the air for thirty-six hours. It has been obtained by distillation. Half a teaspoonful destroyed a dog in less than five minutes; and a slave condemned to death was killed in as short a time by thirty-five drops of the liquid.[1] De Keyzer relates that four barnyard fowls died from the administration of the expressed juice of the root, in from thirteen to sixteen minutes; a large dog in twenty-seven minutes, from two ounces of the liquor; a cow to which an undetermined quantity was given died within an hour. She at first was attacked with brief spasms, and was then affected rapidly with weakness and general loss of power.[2] In 1796, Dr. Clark, of Dominica, described its sudden and fatal effects on man and beast, comparing them with those of prussic acid. He mentions, as the principal symptoms produced, spasmodic constriction of the throat, convulsions, coma, and death, with dilated pupils.[3] De Keyzer relates four cases, three of which were of children, in whom the symptoms were of the same description: but they all recovered. This union of a deadly poison with a highly nutritive substance is met with in the case of bitter almonds and some other fruits, and most frequently the poison is found to be prussic acid or a substance convertible into it (amygdalin?) by the operation of the stomach. MM. Henry and Boutron-Charlard, however, found free hydrocyanic acid in the bitter cassava root.[4]

History.—Tapioca was described by Piso, in the middle of the seventeenth century, under the title Radix Mandihoca.[5] This author mentions the demulcent and nutritive qualities of the starch, and the poisonous nature of the juice of the root. The same peculiarity is noticed by Petrus Martyr.[6]

Uses.—Tapioca is chiefly used as food for infants and for the sick. Dr. Christison says: "No amylaceous substance is so much relished by infants about the time of weaning; and in them it is less apt to become sour during digestion than any other farinaceous food, even arrowroot not excepted." Mucilage of tapioca may be made as follows: Take a tablespoonful of tapioca, macerate it in a pint of warm water for an hour, and then boil it for ten minutes, stirring all the time. Sugar may then be added, with lemon-juice, or currant jelly, nutmeg, wine, etc., to give it a flavor, neutralize its somewhat pasty taste, and adapt it to the condition of the patient.

[1] Dict. de Mat. Méd., iii. 677.
[2] Journ. f. Pharm., etc., i. 586.
[3] Med. Facts and Obs., vii. 289.
[4] Mém. de l'Acad. de Méd., v. 212.
[5] De Indiæ utriusque re naturali, etc., p. 114.
[6] Sprengel, Hist. Rei. Herb., ii. 370.

FATTY AND OLEAGINOUS LENITIVES.

ADEPS.—Lard.

Description.—Lard is the prepared fat of the hog (*Sus Scrofa*). It is separated by means of heat and water from the blood, cellular tissue, and other impurities mixed with it. When pure, lard is a white, granular, unctuous soft solid, of faint taste and smell. It is insoluble in water, but is partially soluble in alcohol and in ether. According to Braconnot, it is composed of 62 per cent. of olein and 38 per cent. of margarin and stearin. It speedily becomes rancid by keeping, and to prevent this change it is usually mixed with salt. When employed for medicinal purposes, this addition must be removed by melting the lard in water, agitating it so as to abstract all the salt, and then cooling it until the pure lard concretes on the surface of the liquid. The addition of benzoin to lard prevents it from becoming rancid.

History.—Pliny[1] mentions as the etymology of *axungia*, the Latin word for lard, *axis*, axle, and *ungere*, to anoint, because the ancients made use of lard to grease the axles of their carriages. He speaks also of fresh and of salted lard, and of its use as an emollient, warming, resolvent, and detergent remedy; of the value of fresh lard as a dressing for burns, frost bite, and abrasions, and of inunctions with it to relieve muscular fatigue. He refers particularly to its internal administration for the cure of phthisis, when it is boiled with old wine, from which it is evident that the present treatment of the disease by oily substances is not new. Celsus says: "It is necessary for the body to be anointed, and gently rubbed even in acute and recent distempers."[2] Dioscorides[3] describes at great length the mode of preparing lard and other animal fats for medicinal purposes; and Galen is equally copious in detailing the uses of each of them. He states that lard is the most emollient of them all, and the most appropriate excipient in making all kinds of ointments, while olive oil is more stimulating or heating. It may not be uninteresting to notice that of bear's grease, he says: "Even were it true, as some maintain, that it is a cure for baldness, yet we possess far more efficient remedies for this affection."

Action and Uses.—Lard is familiary known as an article of food, and is extensively employed in the culinary art. It is with difficulty digested by delicate stomachs, and should never be used without a large admixture of some farinaceous article.

As a medicine it is seldom administered internally, except among the vulgar as a laxative in infantile cases of bowel complaint. Externally it is in constant use, but less on account of its own virtues

[1] Hist. Nat., lib. xxviii. cap. xxxvii.
[2] Book ii. chap. xiv.
[3] Mat. Med., lib. ii. cap. lxix.

than because it is the usual excipient of medicinal substances which are to be applied in the form of ointment. After the example of the ancients, it has been employed and highly recommended (1837) by Wolters, a German physician, as a remedy for *phthisis*. This person prescribed repeated and prolonged frictions of the back and breast of consumptive patients with a piece of the subcutaneous fat of pork still attached to the integument. More recently (1848) Dr. Schneeman, of Hanover, proposed this treatment in *scarlet fever*, alleging that it not only relieved the burning and itching of the skin, but also modified the affection of the throat, and protected against the sequelæ of the disease.[1] It was employed extensively by Mauthner, of Vienna, and received his commendation; and Dr. J. F. Meigs has found that the less offensive application of glycerin and cold cream has the effect of lowering the pulse, alleviating the external heat, dryness, itching, and irritation, and diminishing the injurious effects of the disease upon the constitution at large.[2] From what we have observed, these effects are unquestionable, and afford a sufficient ground for employing the remedy; but we have seen no evidence of its being curative in cases which would not otherwise have recovered.

Mauthner, Schneeman, and others also employed inunctions of lard in *measles*, and with more favorable results, it is said, than are obtained by the method in common use.[3]

In scarlet fever the inunctions should be applied twice a day or oftener, according to the heat of the skin, and as much as possible over the whole surface of the body. The operation is, however, sometimes found annoying, and, after having been several times repeated, the bed linen becomes so much soiled that, unless the inunction appears necessary, a repugnance is felt on the part of the attendants as well as of the patient, to its being continued.

AMYGDALA AMARA.—Bitter Almond.

Amygdala Dulcis.—*Sweet Almond.*

Description.—Almonds are the seeds of the bitter and the sweet varietes of *Amygdalus communis*, a tree which is a native of Asia Minor and Africa, and is cultivated in the South of Europe and partially in the southern portions of the United States. It is usually fifteen or twenty feet in height, with spreading branches, and bears numerous white or pinkish flowers. The fruit is a drupe with rather a membranous than a fleshy covering, which, when ripe, opens and exposes a shell within which is the kernel. According to the qualities of the latter, almonds are divided into *sweet* and *bitter*.

History.—The almond is one of the most ancient of fruits. It

[1] Lancet, Sept. 1849.
[2] Diseases of Children, 2d ed., p. 523.
[3] Bull. de Thérap., lv. 141.

was among the articles which Jacob sent into Egypt to redeem his son.[1] In the Hippocratic writings almonds are stated to be warming and nutritive, are recommended with squill and honey for internal purulent discharges, in emulsion for pulmonary affections and for leucorrhœa, with honey and wormwood for jaundice, and externally in excoriations about the genitals. Bitter almonds are also directed in hysteria, and for a lotion to remove freckles.[2] The latter application is mentioned by Dioscorides, who also advises a decoction of the root for the same purpose, a suppository of almonds to bring on the menses, a cataplasm of bruised almonds for pain in the head, etc. Internally, he says, they alleviate pains, open the bowels, promote sleep, excite the urinary secretion, and are useful in hæmoptysis. Five or six bitter almonds taken before supper prevent intoxication. The bitter variety, he adds, is more useful in medicine than the sweet.[3] Pliny describes different varieties of the almond tree, which, he states, came originally from Pontus, whence the fruit had the name of Pontic nuts.[4] He attributes to bitter almonds the more active properties enumerated above, and says of sweet almonds that they are less active as medicines, but are laxative and diuretic.[5] Galen included bitter almonds among the attenuant medicines; according to him, they cleanse the liver of inspissated humors, remove spots from the skin, promote the expectoration of mucus, and are useful for pains in the spleen, kidneys, and bowels. By the Arabian authors they are described in nearly the same terms; one, however, prescribes an emulsion of almonds for dysury, and states that they increase the secretion of semen; another recommends their emulsion for a dry cough, and, according to Rhazes, when eaten with sugar they are fattening in a high degree.[6]

1. **Sweet Almonds.**—When deprived, by soaking in hot water, of their epidermis, which is bitter, they have a bland, mucilaginous, and sweetish taste. On being triturated with water they form a white emulsion known as milk of almonds. This peculiarity is due to their containing, besides fixed oil, sugar, and gum, an albuminous substance called *emulsin*, which coagulates at the boiling heat of water, and is precipitated from its solution by alcohol.

Action and Uses.—Sweet almonds have been used to prepare a flour which is often used by *diabetic* patients with advantage, as a substitute for ordinary bread.[7] Emulsion of sweet almonds (Mistura Amygdalæ), which is the form in which they are generally employed in medicine, is demulcent, nutritious, sedative, and slightly diuretic and laxative. It is made by triturating in a mortar half a troyounce of freshly-blanched almonds with thirty grains of gum Arabic and 120 grains of sugar, and then adding gradually half a pint

[1] Genesis, xliv. 11.
[2] Dierbach, Arzneimittel des Hippokrates, p. 48.
[3] Lib. i. cap. cxxxix.
[4] Hist. Nat., lib. xv. cap. xxiv.
[5] Ibid., lib. xxiii. cap. lxxv.
[6] Ebn Baithar, ed. cit., ii. 442.
[7] Dr. F. W. Pavy, who first suggested the use of this substance, has succeeded in having prepared a flour in which the excess of oil and saccharine matter belonging to the almond has been removed. (Researches, etc., on Diabetes, 2d ed. p. 250.)

of distilled water, and straining the mixture. It may be drunk *ad libitum*. It is much used in Europe, and deserves to be in this country, in all internal inflammations, as a demulcent and soothing drink. It is especially useful in acute affections of the air-passages and of the primæ viæ, and in all irritations of the urinary passages. It may also be employed as a vehicle for medicines which tend to nauseate or to irritate the stomach or bowels, but in this respect it is generally inferior to mucilage of gum Arabic. Externally, it may be applied as a sedative and emollient lotion in all cases of cutaneous irritation.

The *expressed oil of almonds* (OLEUM AMYGDALÆ EXPRESSUM) is a singularly bland and agreeable oil, and very useful as a demulcent. It was particularly recommended by Sydenham in the cough of phthisis, and may be used in all irritations of the respiratory passages. It is prescribed in emulsion.

2. **Bitter Almonds.**—These almonds, which are somewhat bitter to the taste, owe their peculiarities to a proximate principle called *amygdalin*. When the emulsin, which they also contain, is mixed with water, it acts as a ferment upon the amygdalin, converting it into hydrocyanic acid and volatile oil of bitter almonds. The presence of water is essential to these changes, for without it a perfectly bland oil, like that from sweet almonds, can be obtained from the bitter variety by pressure or by heat.

The *oil of bitter almond* (OLEUM AMYGDALÆ AMARÆ) is obtained by distilling with water almonds from which the fixed oil has been removed by expression. Its active properties depend mainly upon the hydrocyanic acid which it contains, and it forms a convenient mode of administering that agent. It may be prescribed in the dose of a quarter of a drop and from that to a drop and a half in an emulsion.

Action of Bitter Almonds.—As already stated, bitter almonds become poisonous by reaction with the water of the animal fluids; and many instances are recorded of alarming symptoms, and some of death itself having been produced by them in man. According to the experiments of Wepfer a drachm of the pulp is sufficient to kill a pigeon or a kitten; Hiller gave three ounces of bitter almonds to a cat without destroying it, although the animal had convulsions, foamed at the mouth, etc.; Viborg gave a horse as much as three-quarters of a pound of bitter almonds, when the pulse became small, and the animal appeared dull, but was not otherwise affected.[1] According to Orfila twenty bitter almonds, each cut into three pieces, will kill a dog in six hours, if the gullet is tied.[2]

In man, symptoms of poisoning are also produced by these nuts. Orfila relates such a case concerning two children. Within a quarter of an hour pallor and collapse of the features, dilated pupils, sighing respiration, somnolence and muscular relaxation, indicated the nature of the accident. In large quantities their poisonous effect may be very sudden. A case is reported by Kennedy of a

[1] WIBMER, Wirkung, etc., i. 155. [2] Toxicologie, 5ème ed., ii. 423.

man who fell down dead after eating a large quantity of bitter almonds; there was frothing at the nose and mouth, and the eyes continued fixed and glistening.[1] In many instances the bitter almond gives rise to annoying, but less serious, symptoms, and particularly to a copious eruption upon the skin resembling urticaria; but as the sweet almond sometimes has a similar effect, it must be attributed to personal peculiarities, rather than to a specific poisonous action.

The oil of bitter almonds is one of the most powerful of poisons. According to Dr. Taylor, one hundred parts of the oil contain nearly thirteen parts of anhydrous prussic acid.[2] One drop of it is sufficient to kill a cat. This was shown by the experiments of Sir B. Brodie, who also illustrated in his own person its subtle power. Dipping the blunt end of a probe into the essential oil, he applied it to his tongue, meaning to taste the oil, for he had no suspicion that so small a quantity of it could produce any of its specific effects on the nervous system; but scarcely had the instrument touched his tongue when he experienced a very remarkable and unpleasant sensation, which he referred chiefly to the epigastric region. At the same time there was a sense of weakness in the limbs, as if he had not command of his muscles, and he thought that he was about to fall. The sensations were, however, momentary.[3] In a case reported by Mertzdorf, the patient, a hypochondriac, forty-eight years of age, swallowed two drachms of the essential oil of bitter almonds. His features became spasmodically contracted, his eyes fixed, upturned, and starting from his head, and the breathing jerking and hurried. Death took place in half an hour.[4] Several cases of the same sort are reported by Orfila and Taylor. On the other hand, instances are cited by these and other toxicologists to show that large doses of the substance in question may be taken without fatal consequences. Thus, while seventeen drops have been known to cause death, recovery has taken place after a dose of thirty drops; but vomiting occurred a few minutes after the poison was swallowed.[5] A like result ensued in the case of a boy twelve years of age, after taking nearly a tablespoonful[6] of the oil. In this instance remedial measures were at once adopted. In another case, a boy four years of age swallowed four or five drachms of the oil, and, as in the other examples quoted, violent symptoms were instantly manifested; but assistance was at hand, and in half an hour the patient was out of danger.[7] From these

[1] Wibmer, from Lond. Med. and Phys. Journ., Feb. 1827.

[2] From some experiments by Mr. W. Price Jones, it appears that the purified oil of bitter almonds, *i. e.* deprived as far as possible of its hydrocyanic acid, is not in a high degree poisonous. (Lancet, Jan. 10, 1857, p. 45.)

[3] Physiological Researches, p. 45.

[4] Journ. Complémentaire, xvii. 366.

[5] Chavasse, Lancet, 1839, p. 930.

[6] Taylor, On Poisons, 1st Am. ed., p. 572.

[7] Lancet, Jan. 1855, p. 34. For other cases, see Times and Gaz., Oct. 1858, p. 511; Br. and For. M.-C. Rev.. Oct. 1862, p. 531; Lancet, Mar. 1866, p. 255; Ranking's Abst., xlviii. 86.

cases it must be apparent that too much caution cannot be exercised in dispensing this powerful medicine.

Uses.—The preceding account shows that the cases to which bitter almonds are applicable, in virtue of their sedative properties, are the same as those in which hydrocyanic acid is administered. In such cases the essential oil may be prescribed, in doses of from one-quarter of a drop to a drop, in emulsion. But when a demulcent as well as a sedative operation is required, the emulsion of bitter almonds is to be preferred. It is made in the same manner as the emulsion of sweet almonds (*vid. supra*). It is very palatable, and is an eligible preparation in catarrhal affections of all the mucous membranes. The *syrup of almond* (SYRUPUS AMYGDALÆ), which is prepared with both sweet and bitter almonds, is useful under the same circumstances, largely diluted with water. It is commonly prescribed in cases of gonorrhœa to diminish the acrimony of the urine. The simple almond emulsion forms a soothing lotion for parts irritated by chafing, by exposure to heat, or by slight cutaneous eruptions. As before stated, it has long been employed to remove sunburn and freckles.

CETACEUM.—SPERMACETI.

Description.—"A peculiar concrete substance obtained from *Physeter macrocephalus.*" This cetacean, commonly called the great-headed cachelot, and vulgarly confounded with the whale (*balæna*), inhabits gregariously the Atlantic and Pacific Oceans, and formerly was found in every latitude, but it is now chiefly met with in the Southern Ocean. It is from forty to seventy feet in length, and twenty feet in thickness; its upper part is grayish and its belly white; it has a disproportionately large head, two small pectoral fins and a very large caudal fin, remarkably small eyes, and a single spout hole. Its lower jaw is furnished with large conical teeth, which are received into corresponding depressions in the upper jaw. The spermaceti is a peculiar fluid contained in an immense cavity above and outside of the cranium, and covered with a tendinous and cartilaginous integument. This cavity is subdivided internally into numerous cells communicating with one another, and with canals and dilated portions, all of which are filled with the substance in question. In its recent state it is liquid, but on the death of the cachalot it congeals. Before entering into commerce, it is freed from oil and cellular substance by repeated compression, melting in water, skimming, and washing with a weak alkaline solution.

Pure spermaceti is a white solid, of a foliaceous crystalline structure, and pearly lustre, inodorous and almost tasteless, and of a somewhat unctuous feel. It is insoluble in water, and but slightly soluble in cold alcohol, but is more so in boiling alcohol, ether, and the volatile and fixed oils. It may be pulverized with the addition of a small quantity of alcohol or almond oil. Spermaceti contains neither oleic nor margaric acids, but a peculiar acid, the *ethalic* or

cetylic (which, however, is stated to be a compound of several other acids), in combination with a base called *ethal*. Accordingly pure spermaceti is an ethalate or cetylate of ethal or the hydrated oxide of cetyle.

History.—This substance, which does not appear to have been known to the ancients, derives its name from a superstition which prevailed during the middle ages, that it constituted the seminal fluid of the animals from which it is procured. Subsequently it was supposed to be the cerebral substance of these animals. Pomet[1] stated a century and a half ago that it was seldom used in medicine, but chiefly as a cosmetic by ladies of quality.

Uses.—Formerly spermaceti was, as we have both poetical and professional authority for stating, regarded as a sovereign remedy "for an inward bruise." In fact it was considered a demulcent and sedative remedy for all pulmonary and intestinal affections, and even for painful disorders of the urinary organs. We have known it to be administered in powder with white sugar for the relief of bronchial catarrh. But most frequently it is given for the purposes specified, in the form of an emulsion made with the yolk of egg and sugar, or with almond oil.

Externally, spermaceti is frequently employed as an ingredient of ointments, and is often more eligible than lard for this purpose, on account of its blander qualities and its greater tenacity, especially where a simple protective is alone required. Ointment of rose water (*Unguentum Aquæ Rosæ*), or cold cream, as it is popularly called, spermaceti ointment (*Unguentum Cetacei*, Br. Ph.), and spermaceti cerate (*Ceratum Cetacei*), are preparations of this description. They are especially useful in healing chapped lips and hands and all superficial abrasions, excoriations, and burns. The first named of these, with the addition of a little benzoin to preserve it from rancidity, tincture of alkanet to give it an attractive color, and oil of rose or bergamot as a perfume, forms an agreeable and useful lip-salve.

GLYCERINA.—Glycerin.

Description.—Glycerin, or oxide of glyceryle, is a substance existing as the organic base of the fatty acids (stearic, margaric, oleic, etc.), and is liberated from them when they combine with alkaline bases to form soaps. It was discovered by Scheele, in 1789, and more fully investigated by Chevreul in 1811. From its flavor, Scheele denominated it "the sweet principle of fats," and hence it received the name which it bears, *glycerin*, from γλυκος, sweet. It may be prepared by mixing litharge (oxide of lead) with a fixed oil and boiling water, by which the fatty acids unite with the lead and are precipitated, and the glycerin remains in solution. It is then freed from any lead it may retain by means of a stream of sulphuretted hydrogen gas, and purified from the latter by boil-

[1] Histoire des Drogues, Paris, 1706.

ing, and from other impurities by filtration through animal charcoal. A more direct method, and one by which a purer glycerin is produced, is that originally patented by Mr. Tilghman, of Philadelphia, and improved by Messrs. Price & Co., of London. It consists in blowing steam at a high temperature (550° to 600° F.) through fat, and receiving the fatty acids and the glycerin in a condenser, where their different specific gravities cause a separation between them, the glycerin subsiding, and the fatty acids remaining supernatant.

Glycerin is a colorless or straw-colored liquid, of a syrupy consistence, with a sp. gr. of 1.25; it is somewhat unctuous to the touch, inodorous, and of a very sweet and pleasant taste. It is perfectly soluble in oils, alcohol, and water, but is insoluble in ether. It gives a slightly acid reaction. Its general solvent power is almost equal to that of water, and is greatly increased by a high temperature. According to Klever 100 parts of glycerin dissolve the annexed quantities of the following substances.[1]

Acid. arseniosum	20	Morphiæ acetas	20
" arsenicum	20	" murias	20
" benzoicum	10	Phosphorus	0.20
" boracicum	10	Plumbi acetas	20
" oxalicum	15	Potassæ arsenias	50
" tannicum	50	" chloras	3.50
Alumen	40	Potassii bromid.	25
Ammonia carb.	20	" cyanid.	32
" muriat.	10	" iodid.	40
Antimon. et potass. tart.	5.50	Quinia	0.50
Atropia	3	Quiniæ tannas	25
Atropiæ sulph.	33	Sodæ arsenias	50
Barii chlorid.	10	" bicarbonas	8
Brucia	2.25	" boras	60
Calcii sulphid.	5	" carbonas	98
Cinchonia	0.50	" chloras	20
Cinchoniæ sulph.	6.70	Sulphur	0.10
Cupri acetas	10	Strychnia	0.25
" sulphas	30	Strychniæ nitras	4
Ferri et potass. tart.	8	" sulphas	22.50
" lactas	16	Urea	50
" sulphas	25	Veratria	1
Hydrarg. chlor. corros.	7.50	Zinci chloridum	50
" cyanid.	27	" iodidum	40
Iodinium	1.90	" sulphas	35
Morphia	0.45		

The following are insoluble in glycerin: carbolic acid, fatty acids, cocoa butter, benzine, camphor, chloroform, the bromide and the iodides of mercury, calomel, iodide of lead, and resins. Very strong preparations may be made with glycerin of senna and rhubarb. It also dissolves the essential oils. It has no tendency to ferment or become rancid, nor does it evaporate on exposure to the air. It has also the power of preserving animal and vegetable substances from decomposition. If free from rancid oils, it ought to emit no smell when rubbed upon the warm hand. The officinal preparations in which glycerin is employed as a solvent are called *glycerites*.

[1] Boston Med. and Surg. Journ., Aug. 1870, p. 127.

Action and Uses.—Glycerin is said to be perfectly bland and unirritating, but we have found the purest article occasionally the reverse, owing, it may be, to its abstracting moisture from the part to which it was applied. From the tenacity with which it retains and attracts moisture, it remains unaltered by a high temperature. Mr. Startin affirms that a common plate wetted with it may be kept in an oven, side by side with a joint of meat, till the meat is cooked, without any sensible diminution in the quantity of the liquid.[1] These observations seem to show that a perfectly pure (anhydrous) glycerin is not the best adapted to fulfil the objects to which it is applied as a protective agent. Dr. Hager, however, has pointed out that the irritant properties of certain specimens of glycerin may be due to their containing oxalic and formic acids, and sometimes ammonia. M. Shopky has detected, in glycerin reported to be pure, the presence of nitric acid, fatty volatile acids, and alkalies, and traces of chlorine, lime, and sulphuric acid. M. Perutz has met with butyric acid, and Mr. Watts chloride of calcium in specimens of glycerin also reported to be pure.[2]

Like all other substances newly applied to medicinal uses, glycerin has had virtues attributed to it which are probably exaggerated if not unreal. As a *nutrient*, it has been compared with cod-liver oil; and, as it is rich in carbon and hydrogen, the view seemed not to be improbable. Dr. Gilchrist used it in a case of mania, where it appeared to retard, if not to neutralize, the exhausting process.[3] Dr. Crawcour, of New Orleans, substituted it for cod-liver oil in the cases for which this medicine is usually given, and reported it successful in several cases of *phthisis* of *scrofulous disease* generally, and in *mesenteric disease* in children. He also used it as a very convenient vehicle for iron, quinia, and iodine, in the same cases.[4] Cases illustrative of its use have been furnished by several Scottish physicians.[5] Dr. Cotton, Physician to the Brompton Hospital for consumption, has, however, shown conclusively that glycerin has generally but little influence upon phthisical cases, and that as a remedial agent in consumption it will bear no comparison with cod-liver oil;[6] a conclusion in which we entirely coincide.

As a *topical* application, the usefulness of this preparation is much more evident. In *dysentery*, an enema containing one part of glycerin te five of flaxseed tea, has been found one of the best means of soothing the irritated rectum, and suspending the tenesmus.[7] Dr. S. Scott Alison has applied it to the *larynx* and trachea in cases of pulmonary disease, attended with dryness or irritation of these parts.[8] Dr. R. Mayer, of Wilkesbarre, Pa., used glycerin with ad-

[1] Am. Journ. of Med. Sci., July, 1846, p. 222.
[2] Dublin Quart. Journ., Aug. 1870, p. 181.
[3] Edinb. Journ., ii. 920.
[4] N. Y. Journ. of Med., March, 1855, p. 309.
[5] Lindsay, Edinb. Journ., ii. 915.
[6] Med. Times and Gaz., June, 1857, p. 641.
Bull. de Thérap., lviii. 521.
[8] The Medication of the Larynx and Trachea, p. 20.

vantage to soften the plugs of hardened mucus which obstruct the nasal passages in some forms of chronic coryza, and also as a local application to the interior of the larynx in membranous croup. In the latter case he found that when the liquid was applied to the orifice of the larynx, by means of a large camels-hair pencil, there was a manifest softening of the tone of breathing and cough, and considerable reduction of the dyspnœa and general distress.[1]

One of the earliest uses of glycerin was that proposed by Dr. Turnbull. Mr. Yearsley had called attention to the improvement in hearing of persons in whom the tympanum was partially destroyed, when a pellet of moistened cotton-wool was introduced into the meatus, but Dr. Turnbull, finding that the necessity of constantly renewing the moisture of the pellet was a great inconvenience, conceived the idea of moistening it with glycerin instead of water, which proved to be a much more permanent expedient. In other cases of perforated tympanum causing deafness, he filled the auditory canal with a solution of equal parts of glycerin and water, and causing the patient to inspire, in this manner cleansed and lubricated the Eustachian tube.[2] Mr. Wakley, Jr., found this liquid peculiarly serviceable in tinnitus and hardness of hearing occasioned by cuticular or epithelial *thickening of the meatus* and of the tympanum. By filling the auditory canal with glycerin, and retaining it in the passage by means of a plug of gutta percha, the epithelial secretion gradually softens and breaks into pieces which can be removed by means of a syringe or with the forceps.[3]

Besides the softening influence exerted by glycerin under the circumstances above stated, it is eminently useful in protecting inflamed parts from the air and external irritants. This is shown by its favorable action upon *wounds* and *ulcerated surfaces*. According to Demarquay, and also to Guibert,[4] its advantages over ointments as a dressing for wounds consist in its superior cleanliness and facility of application, its unirritating qualities, and its limiting the secretion of pus.[5] M. Lutton, who witnessed the results of the treatment used by M. Demarquay, fully confirms these statements, adding that glycerin, by its hygrometric qualities, prevents the hardening of pus upon wounds, and by its miscibility with this secretion comes more perfectly in contact with the affected part than any ointment can do. He assures us that it is preferable to all other dressings for burns, hospital gangrene, and suppurating surfaces generally.[6] M. Demarquay has also treated vaginal *leucorrhœa*, after the acute stage, by means of tampons saturated with a solution of one part of tannin in four of glycerin. He reports four cases of rapid and complete cure.[7]

These effects are ascribed by Dr. J. Marion Sims to the affinity

[1] Am. Journ. of Med. Sci., April, 1858, p. 338.
[2] Lond. Med. Gaz., June, 1849, p. 962.
[3] Lond. Lancet (Am. ed.), July, 1852, p. 39.
[4] Hist. Nat. et Méd. des Nouveaux Medicaments, 1865.
[5] Bull. de Thérap., xlix. 422.
[6] Abeille Méd., xiii. 31.
[7] Bull. de Thérap., l. 540.

of glycerin for water. When a cotton tampon saturated with glycerin is applied to an ulcerated or inflamed cervix uteri and removed in a few hours, it leaves the surface clean and dry. Acting on this hint, Dr. J. H. Griscom[1] applied glycerin dressings to *boils, carbuncles and abscesses* in various situations, with the effect of arresting their development when the skin was sufficiently thin to permit transudation, or had been rendered soft by the previous application of a poultice.

Dr. Brinton made use successfully of a lotion consisting of two scruples of borax, one ounce of glycerin, and four ounces of water, in case of *fissured tongue* which had baffled all attempts at alleviation for many years.[2] Van Holsbeck found a tent saturated with a solution of glycerin and tannin (1 part to 16), and introduced carefully into the rectum, night and morning, an excellent dressing for *fissures of the anus.*[3] A similar solution is not less efficacious in the treatment of *fissure of the nipple;* but for this affection, and for *chapped hands*, we prefer a liniment made by adding one part of tincture of benzoin to six or eight of glycerin, and filtering the mixture. A benzoated glycerin ointment is also prepared, and answers a similar purpose.

Glycerin as a remedy for *diseases of the skin* was first used by Mr. Startin in the treatment of *pityriasis* and other squamous disorders,[4] in 1845, since which time it has been employed by many physicians for similar purposes. Among them Mr. Shaw made use of it in pityriasis,[5] Trousseau and Bazin in *prurigo*,[6] Sère de Muret in the same affection,[7] Bourguignon in *scabies*,[8] Stirling in *psoriasis*,[9] and Bougard in *eczema.*[10] But other and later observers, while admitting its virtues in papular eruptions and pityriasis, deny them in respect to vesicular and pustular affections. It has, indeed, been used in almost every description of cutaneous eruption, and for the relief of the *stings of insects.* In many cases of the former it evidently aggravated the disease by the irritant qualities of the glycerin employed, and in few or none did it evince any superiority to the fatty substance usually employed. Dévergie, who made extensive trials of it, arrived at a similar conclusion, and observed further that when a large portion of the body was covered by the preparation its affinity for moisture kept the clothing of the patients constantly wet, and in cold weather rendered them very uncomfortable.[11] It may nevertheless be employed with advantage in various circumscribed affections of the skin, and particularly in such as are attended with severe itching. It has been strikingly serviceable in *pruritus vulvæ*, either alone or as an excipient of corrosive sublimate and of various

[1] Trans. N. Y. State Med. Soc., 1868, p. 125.
[2] Ranking's Abs. (Am. ed.), xxv. 89.
[3] Bull. de Thérap., li. 475.
[4] Braithwaite's Retros. (Am. ed.), xiii. 307.
[5] Times and Gaz., April, 1854, p. 347.
[6] Arch. Gén., 5ème ser., iii. 244.
[7] Annuaire de Thérap., xvii. 245.
[8] Edinb. Méd. Journ., ii. 921.
[9] Ibid.
[10] Bull. de Thérap., li. 323.
[11] Ibid., l. 241.

narcotic agents. For this purpose, also, instead of pure glycerin, equal parts of this liquid and of almond oil may be advantageously employed. It is sometimes used advantageously for softening *corns*. A solution of iodine in glycerin is more efficient than glycerin alone. On the whole, it appears, in cutaneous disorders at least, to act chiefly a mechanical part, and protect the affected surfaces from the contact of the atmosphere, without materially modifying their condition. In recent or other local affections which tend to a spontaneous cure, glycerin may hasten that issue, but beyond this it displays no curative virtues.

As a vehicle, solvent, or excipient for pharmaceutical preparations. The remarkable solvent powers of glycerin, together with its bland taste, its unchangeableness, and its neutral relations to the animal tissues, render it, when unadulterated, one of the most valuable excipients that can be used, especially for those medicines which, as above stated, it dissolves more perfectly than water. The compilers of the new U. S. Pharmacopœia have recognized, as a separate class, the solutions of several medicinal substances in glycerin. Mr. Wilson has found that its solutions of the sulphate and the iodide of quinia, of the citrate, iodide, protocarbonate and perphosphate of iron, of tannin, of iodine, etc., form very elegant and permanent preparations.[1] A solution of iodide of potassium in two parts of glycerin with the addition of one part of iodine makes an almost caustic preparation of the greatest value in the treatment of lupus, etc. But a solution of one part of iodine in five of glycerin is sufficiently strong for obtaining the resolvent action of iodine upon enlarged glands, and its revulsive operation in cases of deep-seated disease of the joints, etc. It is recommended to paint the part with the iodized solution once in two or three days, and to cover it with a piece of gutta-percha cloth. Prof. Simpson, of Edinburgh, has used a paste made with one part of glycerin, and eight parts of powdered sulphate of zinc as a *caustic*. Dr. Andrews, of Chicago, states that a solution of the vaccine scab in glycerin keeps for months, even in warm weather, without spoiling, and answers perfectly for vaccination.[2] The Director of the Berlin Vaccine Institution, Dr. Müller, has fully confirmed this statement, by showing that fresh lymph diluted with two parts of pure glycerin, and two of distilled water, forms a mixture with which vaccination may be successfully performed. As no solution of the lymph takes place the mixture must be well agitated every time that it is used.[3]

The best associate of glycerin with which to form an excipient representing the fatty basis of ordinary ointments, is potato *starch*. One part of the latter and fifteen of glycerin, heated together with constant stirring, produces a transparent and unalterable jelly-like substance which constitutes a very grateful and efficient application to the skin, and is so entirely unirritating as to have been employed

[1] Edinb. Med. Journ., ii. 924.
[2] Am. Journ. of Med. Sci., Oct. 1857, p. 561.
[3] Med. Times and Gaz., Jan. 1871, p. 637.

by Simon, von Graefe, and other ophthalmologists in preference to ointments in *affections of the eyes.* It is inodorous, excites no chemical action, and is unaffected by temperature, and, like glycerin itself, may be used as a vehicle for the various medicines which are soluble in it. Von Graefe states that in affections of the edges of the eyelids the ordinary ointments are to be preferred, because they are not so readily dissolved, and, therefore, washed away by the tears; the latter quality, however, renders the new application superior in its effects when it is to be applied to the palpebral or the ocular conjunctiva; for it is in this manner diffused over the whole of the diseased surface. Moreover, the active ingredient, which is usually a metallic salt, instead of being merely suspended, as in an ointment, and therefore mechanically irritating, is perfectly dissolved, and exerts its appropriate medicinal power alone. The objection above referred to against glycerin ointment in psorophthalmia and other affections in which the edges of the eyelids are covered with hardened mucus and pus, does not apply so strongly to the use of pure glycerin for the purpose of preventing or of removing these accumulations, for both of which purposes, indeed, it is superior to every other application, while it does not interfere with the use of whatever curative dressing may afterwards appear to be appropriate.

OLEA FIXA.—Fixed Oils.

Oleum Olivæ.—*Olive Oil.* See *Cathartics.*

Oleum Amygdalæ.—*Almond Oil.* See *Amygdala.*

Oleum Theobromæ.—*Oil of Theobroma. Butter of Cacao.*

Description.—This substance is the concrete oil obtained by expression from the kernels of the fruit of *Theobroma cacao*, a native tree of tropical America. Chocolate consists of these seeds roasted, ground, and mixed with various nutritious or spicy substances.

Cocoa oil or butter is a soft solid of a yellowish-white color, and an agreeable odor and taste; it melts at 95° F., consists of peculiar acids and oils (coccinic, caproic, etc.), and may be kept, it is said, for twenty years without growing rancid. It is but slightly soluble even in warm alcohol, but dissolves readily in ether.

Uses.—It has been used internally as a nutrient and emollient remedy in cases of chronic affections of the lungs and alimentary canal. It is, however, more frequently employed as a dressing for excoriated surfaces, etc. Its mildness renders it superior to lard for this purpose, and it is more emollient than spermaceti. Its property of remaining solid at the ordinary temperature of the air, and

of melting at that of the body, renders cocoa butter the most eligible material for making suppositories. The following substances are used in officinal suppositories; carbolic acid, tannic acid, aloes, assafetida, belladonna, morphia, opium, lead, and lead with opium.

On account of its slight liability to undergo change, this substance forms an excellent covering for surgical and other steel instruments which are exposed to a damp or salt atmosphere.

SEVUM.—Suet.

Description.—Suet is the prepared fat of the sheep (*Ovis Aries*). It was used by the ancients in medicine. Galen ascribes to it qualities more heating and desiccative than those belonging to lard. It contains stearin, olein, and a peculiar liquid principle called hircin.

Uses.—When perfectly fresh, suet forms a suitable dressing for blistered and other excoriated surfaces; but it is very apt to grow rancid, and is then decidedly irritant. It is used as an ingredient of various ointments, cerates, and plasters, in order to give them a firmer consistence than they would derive from lard.

GELATINOUS LENITIVES.

GELATINA.—Gelatin.

Description.—Gelatin is a solid, transparent, corneous, substance, which forms the greater part of the bones, tendons, skin, cellular tissue, and serous membranes of animals. In flesh it is associated with osmazome. It is soluble in boiling water, and forms, on cooling a transparent jelly. When dried, it becomes whitish or yellowish, semi-transparent, hard and tough, has no taste or smell, and is unchanged by exposure to dry air.

Action and Uses.—The experiments of Tiedemann and Gmelin, Edwards, Magendie, and others show that pure gelatin is incapable of supporting animal life, but that this substance may become nutritive when it is combined with other principles, as it is in soup prepared from meat.[1] Pure gelatin is sometimes used for the preparation of soups and jellies for the sick, but they are apt to produce laborious digestion and its consequences. It may, however, be sometimes used in solution as an enema in cases of dysentery with severe tenesmus, *hæmorrhoids*, etc. It has likewise been applied to *cutaneous eruptions* in order to protect them from the air, and in general baths to soften the skin.

[1] On this subject, see an interesting report by M. Bérard; Bull. de l'Acad. de Méd., xv. 367.

A very important application of gelatin is to the formation of capsules for the administration of offensive liquid medicines, such as copaiba, turpentine, etc. Of the same material small cylinders are made, and closed at one end, so that when two of them are fitted into each other by their open extremities, a pill or other small body inclosed within them may be swallowed without offending the palate. Gelatin is also used as a coating for pills, which are dipped into the substance while it is in a liquid state, and then allowed to dry.

ICHTHYOCOLLA.—Isinglass.

Description.—Isinglass is a gelatinous substance prepared chiefly from the swimming bladder of *Acipenser Huso* (sturgeon) and other fishes. Geoffroy states that isinglass is prepared from the skin, entrails, fins, and tail, as well as the swimming bladder of the sturgeon;[1] but the Russian, which is the best variety, is composed entirely of the last-named organ, opened, stretched, and dried.

Isinglass comes in rolls or folded sheets, which are semi-transparent, smooth, and shining, tough and not easily torn except in the direction of the fibres, and without smell or taste. Inferior sorts are more opaque, of a duller aspect, and sometimes of a fishy taste and smell. Cold water softens it, but boiling water dissolves it perfectly, and, on cooling, forms with it a jelly. It contains seventy per cent. of gelatin, and is consequently richer in this constituent than any other natural product.

History.—Celsus mentions isinglass among agglutinant remedies.[2] Pliny describes it as the skin of a fish, says that it is soluble in water and vinegar, and is used for pain in the head, and to hide wrinkles and cure eruption of the skin.[3] Dioscorides and Paulus Ægineta give the same particulars.

Action and Uses.—Isinglass is emollient and nutritive. It is used occasionally in affections of the lungs and bowels, and is peculiarly adapted to cases of chronic diarrhœa and dysentery in children. Dr. John F. Meigs speaks in high praise of the following preparation of isinglass in the cases referred to, and also as a substitute for breast-milk when this cannot be procured of the proper quality. Take a scruple of isinglass, soak it for a short time in cold water, and then boil it in half a pint of water until it dissolves. To this, for a child of a year old, add with constant stirring, and at the termination of the boiling, four ounces of milk well mixed with a teaspoonful of arrowroot, and just before removing from the fire, one or two ounces of cream. Loaf sugar may then be added.

Court-plaster is made by covering strong silk stuff with a solution of isinglass in tincture of benzoin, or by coating oiled silk with the former.

[1] Suite de la Mat. Méd., ii. 27.
[2] Grieve's Celsus, p. 208.
[3] Hist. Nat., lib. xxxii. cap. xxiv.

COLLODIUM.—Collodion.

Although not belonging to gelatinous substances, the physical properties and uses of collodion appear to render this an appropriate place for its description.

Description.—Collodion is a solution of gun-cotton (pyroxylon) in ether and alcohol. It is a slightly opalescent liquid, of the consistence of a thin syrup, and smelling strongly of ether. By exposure to the air the solvent evaporates, and the solution grows more transparent, depositing acicular crystals of gun-cotton.

History.—The introduction of collodion into practice is usually ascribed to Dr. J. P. Maynard, when he was a student of medicine in Boston, in the early part of 1848. It was employed by his preceptor, Dr. Whitney, in more than one hundred surgical cases, some of which were serious, and in all successfully.[1] Dr. H. J. Bigelow, however, claims to have first discovered its qualities and applied them in practice.[2] The name collodion, from κολλώδης, gluey, was imposed by Dr. A. A. Gould, of Boston. In the year abovementioned extensive trials of it were made in England, and especially by Mr. Erasmus Wilson, in diseases of the skin.

Action.—The peculiar properties of this substance depend upon the evaporation of its ethereal portion, in consequence of which it solidifies, and in doing so contracts and becomes strongly adhesive. When, therefore, a portion of the skin is covered with a layer of collodion, a sensation of coldness is experienced, which lasts until the evaporation is completed, and is followed by a sense of constriction, which, if the preparation is applied over a large and sensitive surface, becomes unpleasant, or may even be decidedly painful. Both of these operations, it is evident, tend to drive the blood away from the part, and to hinder its complete return so long as the coating is unimpaired, and in this manner to moderate vascular action in inflammation, preventing, also, or limiting effusion, promoting the absorption of that which is already formed, and, in a word, favoring the occurrence of resolution, the most desirable end of inflammation. But collodion does more than this; it is eminently protective in its operation. Better than the mucilaginous, oily, and other applications of the class, it entirely excludes the part which it covers from the air, by means of an artificial cuticle which is but little affected by moisture, and which is so transparent that the condition of the tissues beneath it can at any time be seen. Its adhesiveness renders the other qualities with which it is associated more permanent, relieving both patient and medical attendant from the necessity of a frequent change of dressing, and enabling the latter to employ mechanical arrangements in the treatment of wounds and other injuries, which would be very difficult, if not impossible, without it.

[1] Am. Journ. of Med. Sci., April, 1848, p. 578.
[2] Ranking's Abstract (Am. ed.), viii. 217.

Uses.—Collodion was at first, and is still, employed as a substitute for adhesive plaster in the treatment of *wounds.* The edges of a wound being accurately adjusted, the skin is thoroughly dried and covered with collodion by means of a brush, each layer being allowed to harden before another one is applied. Among the early achievements with this agent was the successful treatment of a lacerated wound of the perineum in a female. For deep wounds, it was employed in conjunction with strips of cotton cloth, and sheep-skin, together with raw cotton, forming strong, unyielding, adhesive straps, bandages, and encasements. In a case of lacerated wound of the scalp, Dr. Whitney, fearing that sutures might excite erysipelatous inflammation, shaved the hair from the raised scalp, and, by means of collodion, fastened some short and narrow strips of sheep-skin on each flap, a short distance from their edge. These strips were then drawn towards each other until the edges of the wound were brought into close and exact union, and the free ends of the strips were secured together by sutures.[1] After a lapse of eleven years, M. Goyrand, of Aix, apparently in ignorance of the ingenious device of Dr. Whitney, published an account of his successful use of the same method in the treatment of deep wounds.[2] Dr. Goyrand made use of linen instead of parchment, and of strings to be tied instead of a suture, both of which means are probably inferior to those originally proposed and employed. This method has been successfully employed as a substitute for the twisted suture after the operation of hare-lip.

In the treatment of *ulcers* collodion has been found very serviceable under two circumstances, when the ulcer is indolent, and when it is in a situation which exposes it constantly to irritation. In the former case the ulcer should be perfectly dried before the application is made, and then the collodion is to be laid on, beginning with the surrounding skin, and gradually coating the ulcer itself, leaving, however, a small opening in its centre for the escape of the secretions. In the other case, as when the ulcer is seated on the neck of the uterus, Dr. Mitchell, of Dublin, found that by its protecting and constringing power, collodion effected a cure in half the time which is required when nitrate of silver is used.[3] Similar testimony has been furnished by Aran[4] and by Delpeuch.[5] On the same principle, Yvonneau treated a case of fistula of the cheek, using collodion to keep the edges of the incision together. The steady and strong pressure of collodion has been used with signal advantage in the treatment of *carbuncles.* Dr. Seiche, who tested its application in twelve cases, surrounded the inflamed part with a zone of the solution so as to exert pressure upon the base of the swelling, leaving its central and most inflamed portion exposed for the escape of the softened tissues. The extension of the inflammation is prevented and the pain alleviated by this method, and the

[1] Am. Journ. of Med. Sci., April, 1848, p. 578.
[2] Bull. de Thérap., lvi. 335.
[3] Dublin Med. Press, Oct. 1848.
[4] Bull. de Thérap., xliv. 34.
[5] Ibid., li. 176.

duration of the affection materially abridged.[1] In like manner the formation of *bed-sores* may be prevented, and the soreness of other parts liable to excoriation.

In other minor cases, the insolubility of this substance in watery liquids has been found of great use, particularly to preserve slight abrasions or wounds from infection in *dissection*, *surgical operations*, the practice of *midwifery*, etc. Mr. Robinson found it useful as a filling for *carious teeth* when the nerve is exposed. After the cavity is cleansed and dried, he recommends that it should be filled with a small tuft of asbestos saturated with collodion in which morphia has been dissolved.[2]

In other cases it is useful by its constringing as well as its protective property. It serves to arrest excessive bleeding from *leech-bites*, when applied on a small compress to their orifices, and renewed as often as the hemorrhage reappears,[3] and also to protect and heal the wounds made by the scarificator in *cupping*. The protective and compressive action of collodion is well shown in the relief and speedy cure which follow its application to the *bites and stings of insects*.

In *erysipelas* collodion has sometimes been applied with the best effects. The first record of its use in this disease, is that of Dr. Freer, of Illinois, who found, during an epidemic of the disease, that its application gave immediate relief to the local symptoms.[4] Piachaud, of Geneva, reports fifteen cases of erysipelas of the face, in which its influence upon the heat, tension, and throbbing of the part was immediate, the redness at once subsided, and the disease was cured in one-half the time usually required.[5] In order to diminish the constriction of the application, which is sometimes very painful, P. Guersant mixed castor oil with the collodion, in the proportion of one part to fifteen. It must be remembered, however, that erysipelas is not usually a local disease. Although in many cases, even of the idiopathic form, it exhausts itself in the neighborhood of the parts first attacked, in many others it travels beyond them, whatever may be the local treatment employed. This remedy is, doubtless, most effectual, as Christen pointed out, in erysipelas depending upon local causes, such as wounds, ulcers, solar heat, burns, etc.;[6] it is, however, spoken of by Mr. Erasmus Wilson as a valuable topical agent in erysipelas. It also forms an excellent application for superficial *burns*, according to the reports of Drs. Maynard, Payne, and Crawford, in Canada,[7] and of Lambert, at Lyons.[8]

In *smallpox* it was natural that collodion should be employed as an ectrotic remedy, to prevent the development of pustules upon the face and the unsightly scars which too often follow them. The first trial of this treatment in a case of unmodified smallpox was

[1] Prager Vierteljahrs., lxxi. Anal. p. 70.
[2] Lancet, Dec. 1848.
[3] Ibid., Jan. 1849.
[4] Am. Journ. of Med. Sci., April, 1850, p. 545.
[5] Archives Gén., Sept. 1852, p. 5.
[6] Vierteljahrschrift f. d. prakt. Heil., xxxvi. 92.
[7] Brit. Am. Journ., Aug. 1848.
[8] Dieu, Mat. Méd., iv. 489.

made by Aran, in 1850, and appears to have been successful in preventing pitting;[1] but the more numerous trials of Christen, at Prague, led him to conclude that collodion thus applied produces intolerable suffering, does not in any degree retard the development of the pustules, and even seems to be the cause of increased ulceration of the skin.[2] These effects appear to have depended chiefly on the constrictive action of coating, which may be diminished, while the pliancy of the pellicle is increased, by the use of the officinal flexible collodion. Dr. Elisha Harris, of the Marine Hospital, New York, reports as the result of several years' experience, that, although the simple collodion dressing does not, in the majority of cases, prevent suppuration and pitting, yet it seems, in a large proportion of cases, to diminish these unpleasant accidents of the malady. He preferred an opaque solution made by the addition of one ounce of tincture of kino, and two drachms of muriated tincture of iron, to three ounces of collodion. With this each vesicle, or patch of vesicles, was pencilled, from its first development, three or four times daily, and until desiccation was about to commence.[3]

This application has been used with more or less advantage in various diseases of the skin, as *intertrigo*, *herpes labialis*, *h. præputialis*, and *h. zoster ; lichen*, *lupus*, *acne*, *chronic erythema*, *etc.* Two cases of shingles are reported to have been greatly relieved and rapidly cured by this method of treatment.[4] It is said to diminish rapidly the redness, pain, and fever, obliterate the vesicles or arrest their development, alleviate the neuralgic symptoms and prevent ulceration.[5] Equal parts of collodion and castor oil form a preferable application to collodion alone, in this as well as in all similar cases; or the officinal flexible collodion may be used instead. Fissures and excoriation of the *nipples* are more speedily healed by this than by any other application. It is also useful in fissures of the lips and in cases of chapped hands. The addition of tannin to collodion, as in the "styptic colloid" of Dr. Richardson, renders the application more efficacious.

The constrictive action of collodion has been rendered very useful in various affections. According to Bonnafont, who employed it in fifty-five cases of *swelled testicle*, it manifests great energy, especially when the attack is recent, and before the effusion has become solid or organized. In employing it, M. B. directs that it should first be applied to the scrotum near the root of the penis, and gradually extended downwards and somewhat to the opposite side. The application is said to be painful at first, but the pain is not of more than a few minutes' duration.[6] It has also been used with advantage in *varicocele.*

A zone of collodion, an inch and a half or two inches wide, applied around the *nipple*, at the distance of half an inch, is said to

[1] Bull. de Thérap., xxxix. 369. [2] Prager Vierteljahrs., loc. sup. cit.
[3] New York Journ. of Med., July, 1856, p. 137.
[4] Lancet, April, 1859, p. 378.
[5] Finger, Ranking's Abstract, July, 1862, p. 113.
[6] Bull. de l'Acad., xix. 584.

have been a very efficient means of causing its projection in some cases where it was so much retracted that the infant was unable to nurse.[1]

Mahy reports his complete success in treating a case of *umbilical hernia* in an infant, with this application, and Pradier also used it with success.[2] In similar cases we have used it with decided advantage, without, however, effecting a perfect cure. Behrend has reported a case of *spina bifida* successfully treated in the same manner;[3] and Browning and Joynes several, showing its efficacy in obliterating *nævi*, especially where they were found over a bone.[4] Dumas of Montpellier has used the same method in obliterating *cephalæmatomata*, after puncture.[5] Sir Dominie Corrigan claims that *noctural incontinence of urine* may be cured by closing the opening of the prepuce with collodion at bedtime. A fortnight's use of the remedy is sometimes sufficient for the cure.[6]

A variety of substances, particularly of a caustic nature, have been associated with collodion and applied by this means. Such are tannin, iodine, corrosive sublimate, perchloride of iron, cantharides, the sulphates of copper and zinc, iodide of zinc, chromic acid, croton oil, etc. The advantages of such a combination are, that by its means many active medicines can, without difficulty, be kept in contact with parts which are habitually bathed in moisture, or which from their situation render a merely mechanical adjustment of the remedy inconvenient and difficult, if not impossible. Of the preparations named above *cantharidal collodion* (COLLODIUM CUM CANTHARIDE) is officinal. Besides the constituents of collodion it contains cantharides, Canada turpentine, and castor oil. Another officinal preparation is *flexible collodion* (COLLODIUM FLEXILE). It is composed of collodion, Canada turpentine, and castor oil.

Voillemer has proposed that before the *actual cautery* is applied to the skin, the latter should be covered with collodion. In this manner the burning is limited to the actual point or line of actual contact of the hot iron, whereas under the ordinary method the adjacent integument is the seat of a very painful burn.[7]

Application.—In all applications of collodion, the part should be rendered as dry as possible. After the first touch or the camels-hair brush, which ought generally to be used, the collodion should be allowed to dry before a second coating is applied. For protective purposes, a thin layer is sufficient, but to produce constriction, a thicker coating is required. In dressing wounds a piece of patent lint, or of linen cambric, saturated with the liquid, should be laid upon the part after the edges of the wound are accurately coaptated. If the contraction of the collodion is objectionable, this effect may be prevented, and the dressing rendered pliant by the use of the flexible collodion mentioned above.

[1] Bull de Thérap., lv. 139. [2] Edinb. Med. Journ., Jan. 1859, p. 664.
[3] Med. Times and Gaz., July, 1859, p. 20.
[4] Ibid., Nov. 1859, p. 513. Richmd. and Louisv. Journ., Mar. 1868, p. 176.
[5] Bull. de Thérap. lxx. 557. [6] Dublin Quart. Journ., May 1870, p. 113.
[7] Edinb. Med. Journ., xiv. 667.

SACCHARINE LENITIVES.

GLYCYRRHIZA.—Liquorice Root.

Description.—The officinal liquorice root is derived from *Glycyrrhiza glabra*, a native plant of Southern Europe and Syria, but cultivated in France, Germany, and England. The plant has herbaceous stems four or five feet in height, with alternate pinnate leaves, and axillary racemes of blue and white flowers, followed by seed-pods or compressed legumes containing three or four brown kidney-shaped seeds. The root, or rather underground stem, is five or six feet long, and penetrates the soil deeply. When dried and brought into commerce, liquorice root consists of pieces usually about two feet in length, and varying in thickness from a quarter of an inch to an inch or more, wrinkled, and grayish-brown externally, but internally of a yellowish color, rendered brighter by moisture. Its structure is fibrous, and its fracture short and splintery. When chewed it has a sweet but slightly acrid taste; the sweetness of its powder is still more marked. Its virtues are extracted both by alcohol and water. They appear to depend mainly upon a peculiar principle called *glycyrrhizin* by Robiquet. It is not crystallizable, is soluble in boiling water and alcohol, has a very sweet taste, and differs from sugar mainly in not being susceptible of the vinous fermentation. Liquorice root contains, besides gum and starch, an acrid resinous substance, albumen, and saline matters.

A variety of liquorice, known as *Russian*, is the product of *G. echinata*. The root is short, thick, porous, of a light color, and not so sweet as the officinal sort. It usually comes deprived of the outer bark.

Extract of Liquorice (Extractum Glycyrrhizæ) is prepared from the officinal variety by evaporating a decoction of the root. It is produced on a large scale in Calabria and Spain. It is usually in black sticks about six inches long and one inch in diameter, flattened upon one side, and rounded at the ends. It is brittle when cold and dry, but soft and tough in warm and damp weather. In the former case its fracture is very black and shining. It has a sweet but somewhat acrid taste. When refined it loses in some degree the last named quality, and with it probably some of its virtues.

Fluid Extract of Liquorice Root (Extractum Glycyrrhizæ Fluidum) is made by percolation with water, alcohol, and glycerin.

History.—Liquorice root (γλυκύῤῥίζα, *sweet root*) was well known to the ancients. Hippocrates alludes to it as an external application with honey or ointment of roses.[1] Theophrastus speaks of its usefulness in oppressed breathing and cough, and of its peculiar

[1] Dierbach, Arzneim. des Hippoc., p. 75.

power of allaying thirst.[1] Dioscorides says it abounds in Cappadocia and Pontus, that its juice is preserved by inspissation, that it is useful in hoarseness, sore throat, and internal inflammations, and that it quenches thirst.[2] Galen only adds that it has a slight astringency, and the Arabians dwell upon its virtues in affections of the respiratory organs.[3] To this day itinerant venders of liquorice water (*marchands de coco*) abound in Paris, where they are greatly in favor with the populace.

Action and Uses.—Liquorice has at all times been regarded as an agreeable demulcent, having a peculiar tendency to the bronchial mucous membrane. Hence it is sometimes ranked among expectorant medicines. Its *extract* enters as a corrigent into a great variety of preparations, the confection of senna, for example, the fluid extract and syrup of sarsaparilla, various troches or lozenges, the brown mixture, etc. The Prussian Pharmacopœia has a laxative preparation, under the title "Pulvis glycyrrhizæ compositus," which is one of the gentlest and most efficient of remedies for constipation depending upon torpor of the bowels. It is composed as follows: ℞. Senna leaves ℥vj; liquorice root ℥vj; fennel seed ℥iij; sulphur ℥iij; refined sugar ℥xviij. Mix, and reduce by trituration to an impalpable powder. Dose, a small teaspoonful at bedtime in water. Liquorice is peculiarly adapted to correct the acrid or bitter taste of certain medicines, such as colocynth, aloes, quassia, senega, mezereon, guaiacum, and sal ammoniac. The fluid extract is more efficient for this purpose than the solid extract, and is the best adjuvant in solutions of *quinia* for masking the bitterness of that substance. The infusion is employed for similar purposes, and is also a very useful drink in febrile affections attended with much thirst, in diarrhœa, dysentery, diseases of the urinary passages, bronchial inflammations, etc. In these cases it is useful to employ either the root or the extract as an addition to mucilaginous infusions of flaxseed, barley, gum, etc. A small piece of the extract held in the mouth tends to allay cough and keep the fauces moist.

MEL.—Honey.

Description.—Honey is defined "a saccharine liquid prepared by *Apis mellifica*;" but other species of bee in different countries produce it. The liquid contained in the nectaries of many plants, and which the bee extracts, is believed to undergo a change in the insect's stomach, and is then thrown up and deposited in the hive as honey. It always partakes in some degree of the qualities of the flowers from which it is derived, and while in some instances, such as those cited below from the ancients, it acquires in this manner a peculiar and delightful flavor, in others it becomes, for a similar reason, absolutely poisonous. The honey which has been much

[1] Hist. Plant., lib. ix. cap. xiii.
[2] Mat. Med., lib. iii. cap. v.
[3] Ebn Baithar, ed. cit. ii. 67.

used of late years, and is made by bees fed in part upon sugar and water, is a pure but very feeble and insipid product.

The best honey is that known as *virgin honey*, and is produced by draining the comb of young bees. It is of a light amber color, less fluid than water, and sometimes as viscid as oil. By age it becomes still denser and darker, and contains crystalline masses. It has a peculiar odor which, in the most esteemed sorts, depends upon the flowers which furnish it; the taste is in like manner various, but is always very sweet, and leaves after it, especially in the fauces, a slightly acrid impression.

Honey contains crystallizable and uncrystallizable sugar, mannite, coloring matter, gum, and wax, together with a volatile odorous principle, which varies with the flowers from which it is derived.

History.—In the sacred writings honey is repeatedly mentioned as food and as medicine, and also as an emblem of a fruitful land. The Grecian poets celebrated the honey of Hymettus, a hill near Athens, whose base and sides are covered with heath and fragrant flowers. The honey gathered there has even now lost nothing of its ancient reputation. In the Hippocratic writings honey is described as drying and heating unless largely diluted, in which case it was said to purge off bile, but to allay mucous diarrhœa. It was also reported to be diuretic, was recommended with butter in chronic coughs with wasting flesh, and with water it was reputed to appease coughing and promote expectoration. Externally it was employed as an emollient, and to cleanse foul ulcers.[1] Besides Hymettus, Dioscorides mentions Hybla as scarcely less celebrated for the quality of its honey. Hybla was situated near the south side of Mount Ætna, in Sicily. Like his predecessors, Dioscorides speaks of honey as being detersive, aperient, etc., and adapted to the treatment of foul and fistulous ulcers, and to curing wounds slow to heal. With alum it is stated to be a good application in inflammations of the skin; and with rock salt, and dropped into the ear, a remedy for tinnitus and pain in this organ. It is also stated to be destructive of lice when applied to the head, and to soften and permit the elongation of the prepuce. It is particularly recommended as a mouth-wash and gargle in inflammation of the tonsils, uvula, and throat. Among other things this author mentions that honey made in the spring is superior to that gathered in the summer or autumn, and that some varieties of it are poisonous in consequence of the bees living upon certain flowers.[2] Pliny furnishes a full and very interesting account of the natural history of the bee, and the production of honey.[3] He also describes the medical uses of the latter, and of its various compounds, particularly hydromel, mead, and honeyed wine.[4] The Arabian writers state that honey is apt to disagree with persons of an ardent or a bilious temperament; and that when gathered from wormwood

[1] Dierbach, Arzneim. des Hipp., p. 75.
[2] Mat. Med., lib. ii. cap. lxxv. [3] Hist. Nat., lib. xxi. cap. xli.
[4] Ibid., lib. xxii. cap. 1.

blossoms it is stomachic and useful to the liver. They dwell particularly on its advantages in affections of the mouth and fauces, and especially of the gums, and recommend that for curing these disorders it should be mixed with vinegar. They also speak of its singular maturative virtues when mixed with flour and used as a poultice.[1]

Action and Uses.—Honey may be used with other food without any unpleasant effects, in most instances; but there are persons who cannot take even a small quantity of it without feeling the head confused or heavy, while in other cases it generates gas in the stomach and bowels, or occasions diarrhœa. Authors also agree that the honey of particular localities is poisonous in consequence of its being derived from certain noxious plants. Dr. Taylor mentions the oleander (*Nerum oleander*) as one of these plants. *Azalea pontica*, *Daphne mezerum*, *Aconitum*, *Kalmia latifolia*, and others, have also been found to be sources of poisonous honey. Of the poisonous influence of the last mentioned plant, commonly known as *mountain laurel*, a well known instance is related by Dr. B. S. Barton. The honey of bees fed from it proves highly intoxicating. The usual symptoms are dimness of sight, or vertigo, succeeded by delirium which is sometimes mild and pleasant and sometimes ferocious, ebriety, pain in the stomach and intestines, convulsions, profuse perspiration, foaming at the mouth, vomiting and purging, and, in a few instances, death. Such were the symptoms recorded by Xenophon as produced by honey during the retreat of the Ten Thousand. Dr. Bidie, after eating some honey obtained from the Coorg jungle, experienced headache, constriction of the forehead, itching, and an eruption of roseola or urticaria. Subsequently, on partaking again of the same honey, the eruption reappeared, with the other symptoms mentioned, as well as with great prostration, diarrhœa, intense thirst, a feeling of soreness in the throat, and great hoarseness of the voice.[2] At the present day the *internal* use of honey is very limited, sugar having taken its place in many of the formulæ employed by the ancients. It still enters into certain officinal mixtures, as *Mel Rosæ*, and *Mel Sodii Boratis* (*U. S.*), and *Oxymel* (*Br. Ph.*), besides several *confections* (*C. Aromatica; C. Opii; C. Rosæ*), to which, however, it communicates no peculiar virtues. Yet it may, perhaps, be doubted whether the substitution of sugar for honey in pectoral medicines, is, on the whole, a profitable change. Geoffroy says it is very appropriate in affections of the lungs with copious and tough expectoration. Honey is sometimes used as a component of laxative enemata, but it has no advantage over molasses.

Von Maack has proposed a theory of *chlorosis* according to which this disease depends upon an imperfect conversion of the products of digestion into sugar by the liver. He maintains that the curative power of iron in chlorosis depends, not upon its supplying an

[1] Ebn Baithar, ed. Sontheimer, ii. 191.
[2] Madras Quart. Journ. of Med. Sci., Oct. 1861.

element in which the blood is deficient, but upon the power which iron possesses of stimulating the formation of sugar in the liver. If, he continues, we would more directly attempt to cure the disease, we must employ not cane, but grape sugar; and in support of this theory he states as a fact that in the northern part of Schleswig and in many places in Hanover, honey is successfully employed as a popular remedy to cure chlorosis.[1]

As a *local* application, honey is employed in all cases in which a mild stimulant is required, and chiefly to change the character of *ulcerated* or secreting surfaces, when their condition indicates a slow or imperfect movement towards cure. Hence it has in all ages been applied to the gums and buccal mucous membrane to cure *aphthæ* and slight pseudo-membranous deposits, but it is now usual to associate with it borate of soda or chlorate of potassa, which materially increase its efficacy. For these purposes also *honey of roses* and *oxymel* are superior to honey alone. It is sometimes used in cataplasms to promote the suppuration of *boils* and to heal *fissures of the nipple*. It is also said to be an efficient application to the mamma for *drying up the milk*. Honey is extensively used as a domestic remedy in Russia.[2]

Beeswax (CERA FLAVA, AND C. ALBA) is used almost exclusively in pharmacy, for preparing cerates, plasters, etc.; but anciently it was given internally for the cure of diarrhœa and dysentery. In modern times it has occasionally been employed with a similar object, and a few years ago Dr. Hitchcock, of Mich., claimed to have used with excellent results, in the treatment of acute and chronic diarrhœas, *propolis*, a resinous exudation with which the bees cover the bottom of their hives.[3]

SACCHARUM.—SUGAR.

Description.—Sugar is a sweet principle contained in the juice of many plants, in milk, and in the urine of diabetic persons. It is of two kinds, the crystallizable and the uncrystallizable. The former, which is also called *cane sugar*, is derived chiefly from the sugar cane, the sugar maple, and the beet-root; but it also exists in the palm, in many vegetables, as the pumpkin and turnip, and in unripe Indian corn. The latter, called *grape sugar*, and also *glucose*, exists naturally in the juice of grapes and of many ripe acidulous fruits, and in diabetic urine. It is formed from cane sugar when the latter is passing into alcohol by fermentation, and also exists in molasses.

Officinal sugar is the refined product of *Saccharum officinarum*, or sugar cane, an herbaceous plant which is a native of, and is chiefly cultivated in tropical countries. It has a general resemblance to Indian corn, and is composed of a solid, many-jointed

[1] Archiv der wissenschaftliche Heilkunde, iv. 164.
[2] KREBEL, Volksmedicin und Volksmittel Russlands, 1858.
[3] New York Med. Journ., vi. 168.

stem, measuring from six to twelve feet in height, and about two inches in diameter at its thickest part, which also is richest in sugar. The leaves are long, narrow, and sharp, and the flowers, which form a panicle at the summit of the plant, are of a pinkish color.

When the cane is ripe, the tops are cut off to serve for replanting, and the stalks having been removed close to the ground are crushed in a mill, and their juice is received in large cauldrons. It is then gently heated and mixed with a small proportion of milk of lime in order to facilitate the removal of the impurities which rise to the surface. After this operation, the saccharine liquor is rapidly boiled until it reaches a degree of concentration at which it will crystallize upon cooling. It is then drawn off into a large and shallow reservoir, where it cools and undergoes partial crystallization, after which it is transferred either to hogsheads in which the crystallization is completed, and in which by means of holes in their bottom the molasses is drained off, or it is placed in inverted conical earthen pots, open at the apex, so as to allow the liquid portions of the contents to escape. In this condition the product is known as brown sugar. It may, however, undergo a further purification, which consists in placing upon the base of the cones of sugar, prepared in the manner just described, a mass of moistened clay, from which the water percolates through the loaf and carries the impurities with it. It is now more usual to employ refined syrup for this purpose. When prepared for the table and for the use of the pharmacien, confectioner, etc., sugar is still further purified by boiling it with lime-water, or with bullock's blood and ivory black. In order to prevent the decomposition which sugar undergoes at a high temperature, the process is conducted in partially exhausted receivers by means of steam. The resulting solution is transferred to moulds, where it gradually hardens, and is then cleansed by percolation in the manner above described. After this process it is dried, and is known as loaf sugar.

As thus prepared, sugar is of a snow-white color, hard, brittle, porous, and composed of crystalline grains. By friction it becomes phosphorescent in the dark. It is soluble in hot water in all proportions, and in about half its weight of cold water. When its concentrated aqueous solution is allowed to cool slowly, large prismatic transparent crystals are formed, which are known as rock candy. Barley sugar is a transparent amorphous mass made by rapidly cooling sugar melted at a temperature of 356° F. Sugar is soluble in hot, but not in cold alcohol.

History.—Rumphius says[1] that the word sugar is derived from an ancient Indian word, *saccar*, and Ainslie states that this term (or *sakkara*) is used to designate manufactured sugar. According to Royle, a similar name which he writes *jaggary*, is given only to palm sugar in India. Sugar from the cane has been manufactured in Hindostan, Siam, China, and Japan, from the most remote antiquity,

[1] Herb. Amboinense (1747), v. 189.

and at this day its consumption in those countries is enormous, in the form either of raw sugar or of *sugar candy*. The latter is chiefly used in China, where it is said to have been originally made. The etymology of the word candy has somewhat perplexed historians. Rumphius derives it from κάνθος, a cake, referring to the shape of the masses in which it was prepared. So the French use the word *pain*, and the English the word *loaf*, both of which imply the same idea. Salmasius derives candy from καντιον, angular, on account of its splintery fracture. Moseley asks if it does not come from the Indian word *khand*, which, as well as *shukkur*, is a common appellation of sugar in Hindostan.

The first historical allusion to sugar in the writings of Western nations, is furnished by Theophrastus, who lived B. C. 321. He speaks of a sort of honey procured from canes or reeds. Varro, B. C. 68, mentions the exceeding sweetness of the Indian reed (*Indica arundo*), but says that the juice is derived from the root of the plant; and Lucan, in an often quoted line, says of the Indians near the Ganges, "They drink the sweet juices of the tender reed." Dioscorides, in his chapter on Honey, remarks: "There is a sort of concreted honey which is called sugar. It is found upon canes in India and Arabia Felix. It is as hard as salt, and, like this substance, is brittle under the teeth."[1] To this description Pliny adds, "It comes in fragments as large as a filbert, and is only used in medicine."[2] Paulus Ægineta quotes Archigenes as saying: "The Indian salt is like common salt in color and consistence, but resembles honey in taste."[3]

Before the discovery of America or the passage of the Cape of Good Hope, sugar was made in Sicily and in the islands of the Levant. The cane is supposed to have been originally brought thither from India by the Saracens, and from thence transplanted to Spain by the Moors. From these countries it was carried, in the 15th century, to Madeira and the Canary Islands, and thence its culture extended to the island of St. Thomas, in the Gulf of Guinea, where, for a long time, the Portuguese carried it on with great success. Piso says that brown sugar only was produced at this place. It is generally stated that on the discovery of the Western Hemisphere, sugar cane was found growing on the continent, and also on some of the Atlantic islands; but that the art of making sugar was introduced by Europeans.[4] According to Piso, the sugar cane in the province of Rio de la Plata grows spontaneously, and, under the influence of the sun's heat, its juice exudes and crystallizes.[5] This account corresponds with that of Dioscorides, which has been called in question, because, under the ordinary circumstances of its culture, when the cane is annually cut down, its juice does not exude. It may be mentioned, without, however, attributing too much importance to the opinion, that Guibourt denies that the sugar cane is indigenous to any part of America.[6]

[1] Mat. Med., lib. ii cap. lxxv.
[2] Hist. Nat., xii. xvii.
[3] Syd. Soc. ed., i. 318.
[4] Moseley, A Treatise on Sugar, p. 14.
[5] De Indiæ utriusque re nat. et med., p. 108.
[6] Hist. des Drogues, 4ème éd., ii. 117.

In regard to the early notions respecting the action and uses of sugar, the following statements may suffice. Dioscorides says: "Sugared water loosens the bowels, and is salutary to the stomach and bladder, and to ulcers of the kidneys. It is also used as a resolvent application to the eyes." Galen compares it with honey, and describes it as cleansing and laxative, and as useful to the stomach, unless the habit is bilious. The Arabians add to these particulars but little of their own, but one among them mentions the still popular remedy, butter and sugar in hot water for hoarseness, and asserts that the fumes of burning sugar cure coryza. Rhazes says that its excessive use irritates the bowels and debilitates the whole system. According to Avicenna, sugar is less apt than honey to excite thirst, and is also less detergent. The former of these statements is remarkable, for we find at the present day that all the southern nations of Europe employ sugared water as peculiarly adapted to quench thirst.

Modern writers are divided in opinion concerning the usefulness of sugar. The first who ascribed to it injurious qualities was Angelus Sala (*Saccharologia*, 1637), but he speaks only of its excessive use as tending to impair the appetite and digestion, to cause caries and loosening of the teeth, and foul breath, colic, and diarrhœa, besides bilious, scorbutic, and hysterical complaints. Subsequent writers attributed to its ordinary use greater evils still. Garanciéres accused it of aggravating and even causing consumption of the lungs, and maintained that since bitter substances preserve from putrefaction, sweet ones must favor this change.[1] Willis accused the immoderate use of sugar of having contributed to the increase of scurvy. Ray also subscribes to these opinions, and adds that sugar is very hurtful to the teeth, and not only renders them black, but causes them to decay and loosen in their sockets, and to fall out. Of all these opinions concerning sugar, the last is one of the most general and settled. Even Geoffroy, while lauding the lenitive and expectorant qualities of sugar when used medicinally, and its advantages when duly mixed with the food, echoes this objection to its free employment, adding what is now popularly believed, that it promotes the generation of worms, and that it creates flatulence and bile, and destroys the appetite.

Rumphius states that the first person who employed sugar in pharmacy for the preparation of confections and syrups, was Actuarius, who lived in the 11th or 12th century.

Action of Sugar.—Some very interesting experiments performed by Dr. S. Weir Mitchell, of this city, show that when syrup is injected under the skin of frogs, they gradually become cataractous.[2] In this connection it is important to remember that the coincidence of saccharine diabetes and cataract has long been known. It was mentioned by Rollo in the last century; and Mackenzie, writing in 1835, says, "I have in two instances seen lenticular cataract attack women of from 18 to 25, laboring under diabetes mellitus." More

[1] Moseley, op. cit., p. 83. [2] Am. Journ. of Med. Sci., Jan. 1860, p. 106.

recently, and especially since attention was directed to the subject by Mr. France,[1] numerous examples of the coincidence have been published, and many earlier statements of it have been recalled.

Sugar is generally regarded as nutritious food, contributing directly to the growth of the tissues, and especially to the formation of fat. The sleek condition of the negroes in sugar producing localities, during the cane harvest, is cited in support of this belief. But the negroes consume cane juice, and not sugar; and the former contains a number of saline constituents and azotized matters which are not present in the latter. Böcker, who has carefully examined the question, shows that sugar is not directly a fat-producing substance,[2] and that it cannot possibly contribute anything to the nitrogenous tissues. Consequently, he concludes that it cannot be regarded as nutritious.

In this connection the well known experiments of Magendie, and of Tiedemann and Gmelin, may be referred to, for they show that animals fed entirely upon sugar perish in from two to four weeks, with all the evidences of exhaustion and atrophy. The experiments of Dr. Stark are of the same import. A diet of bread and sugar exclusively, produced in him a scorbutic state of the system, with swollen gums, ulcers of the mouth, purple blotches on the skin, and diarrhœa. It is usually stated that he fell a victim to his imprudent devotion to the cause of science, and he certainly earned a martyr's crown by his self-sacrificing zeal; but an examination of his remains revealed the characteristic lesions of typhoid fever.[3] It is a familiar fact, that, in general, persons who consume a large quantity of sugar in the shape of confectionery, lose their appetite, suffer from heartburn, gastralgia, and acid eructations, grow pale and thin, and are subject either to constipation or diarrhœa.

Böcker has shown that sugar, when freely used, diminishes the amount of solid excreta in the urine, or, in other words, lessens the waste of the system in this direction. By the same mode of action it diminishes the amount of carbon and also of oxygen and water in the expired air. Its part, therefore, as an article of food is that of a respiratory element presenting itself to the inspired oxygen as a substitute for the tissues themselves, and thus limiting the waste of the body while it sustains the animal heat. The appetite for it displayed by children appears to be a natural instinct, the effect of which is to enable the system to appropriate for the growth of the organs azotized food which would otherwise be consumed in the production of animal heat.

The power of sugar to allay thirst was known to the ancients, and has already been mentioned; it was also noticed by Stark, and has been illustrated by Böcker.

It is a general belief that sugar when eaten freely injures the teeth. But Moseley says: "This has long been known as a pru

[1] Ophthalmic Hospital Reports, Jan. 1859.
[2] Op. cit., p. 163. [3] Duncan's Commentaries, xiii. 166 and 175.

dent old woman's bugbear, to frighten children, that they might not follow their natural inclination by seizing opportunities, when they are not watched, of devouring all the sugar they can find." Böcker particularly remarks on the pain experienced in the teeth on chewing sugar, and he refers to the experiments of Larrey, who found that sugar enters into combination with the earthy elements of the teeth. By immersing a tooth in a concentrated solution of sugar, it became soft, and the enamel was readily crushed. In spite of some notable examples to the contrary, we apprehend that the injurious action of sugar upon the teeth cannot fairly be called in question, although an experiment of Plenk is recorded which contradicts that of Larrey. Plenk immersed a sound tooth for two months in syrup diluted with water, and at the end of that time it was completely unaltered.[1] Œsterlen, also, after repeated trials, found no such effect as that reported by Larrey. Mantegazza's careful experiments point also to the conclusion that, except in a state of acetous fermentation, sugar is not detrimental to the teeth.[2] It is, however, prudent, after eating sugar, to rinse the mouth well with water.

Uses.—Although of comparatively small utility for its separate medicinal effects, there are few agents more useful than sugar as an associate of other medicines. In solution it appears to be exclusively lenitive, but in the pulverulent form it exerts a stimulant action, perhaps by attracting moisture to itself.

In all *irritations* of the mucous membrane of the fauces and *air-passages*, it is universally employed to allay irritation and mitigate cough and hoarseness. This it appears to do in the case of the throat and larynx partly by its protective influence, and partly also by its increasing the mucous secretion of these parts, and that of the salivary glands. Hence it is peculiarly an appropriate remedy for that tickling sensation which so often excites distressing paroxysms of coughing. Sugared water is said to have produed a curative diuretic effect in some cases of dropsy. It is habitually used, as above remarked, to promote digestion, and, it may be added, to allay nervous excitement. According to some writers sugar manifests anaphrodisiac powers.

The influence of sugar in retarding oxidation of the tissues appears to suggest an explanation of the universal use of this substance in febrile affections as the usual condiment of all mucilaginous, farinaceous, and gelatinous substances employed in those diseases. It is, however, liable to the objection that if too freely used it becomes acid in the stomach and bowels, impairs the digestion, and induces diarrhœa and flatulence.

The quality of sugar just referred to has been applied in the treatment of *diabetes mellitus*, a disease in which the waste of the solids is more excessive than in any other affection. Andral had shown that an entire exclusion of saccharine and amylaceous food does not by any means prevent the formation of sugar in diabetes,

[1] STRUMPF, Handbuch, i. 165. [2] Br. and For. Med.-Chir. Rev., xxxii. 466.

and Bernard discovered that the liver is capable of converting nitrogenous as well as amylaceous substances into sugar. Mr. Pritchard suggested that a treatment might be beneficial which would supply the loss of the saccharine principle, and M. Pierre having used sugar successfully in a case of diabetes, Mr. Budd administered this substance to a patient whom he had under treatment in 1857, and who was then extremely feeble and emaciated. Although, at first, the amount of sugar in the urine was not lessened, the patient improved in flesh and strength, the urine diminished greatly in quantity, and its density fell from 1044 to 1034. The diet used at the same time consisted of bread, butter, eggs, and mutton chops.[1] Dr. Corfe also reports the history of a case which was apparently almost cured by abstinence from farinaceous food and by the use of sugar candy and honey.[2] Dr. Williams, on the other hand, has published the cases of two persons who, under the ordinary treatment, had ceased to lose flesh. In both cases the saccharine diet increased the quantity and the specific gravity of the urine, and produced rapid emaciation. A similar instance of the failure of this treatment is published by Dr. Burd. His patient was excessively reduced by diabetes, and the saccharine treatment produced a still more rapid exhaustion. A like result was obtained by Dr. Bence Jones; his patient declining in weight while the quantity of sugar in the urine increased.[3] On the whole, therefore, it would appear that experience has disappointed the hopes that were for a time entertained of finding in sugar a certain palliative, if not a specific, for diabetes.

Finely-powdered sugar is said to be a remedy for the *hiccup* which nursing infants are subject to from overfeeding.[4] Loaf sugar eaten freely is said to arrest the development of *alcoholic intoxication*, perhaps because, as suggested by Bouchardat, it retards absorption from the stomach. Debout recommends an enema made with a strong solution of sugar (one part of sugar to four of cold water), as an efficient remedy for *ascarides* of the rectum. He supposes it to destroy these entozoa by abstracting their liquid constituents.[5] It is also a very efficient application for the cure of *aphthæ* of the mouth; it is useful in repressing the exuberant and flabby granulations of *ulcers;* as a stimulant for removing *opacities of the cornea;* and in the cure of *granular lids.* Mr. Tait recommends a watery solution for this purpose,[6] but very finely powdered sugar would seem to be more appropriate. In *chronic laryngitis*, when inhaled by a sudden aspiration from a quill or other tube extending from beyond the lips to the fauces, powdered sugar is useful. It has also been used as a sternutatory, and for diluting more active powders intended for application to the *nasal passages.* The fumes arising from burnt sugar have the property of destroying offensive effluvia, and are familiarly used in the sick chamber for this purpose, powdered sugar being strewn upon hot coals or a heated shovel.

[1] Ranking's Abstract (Am ed.), xxvii. 96.
[2] Times and Gaz., Sept. 1858, p. 292. [3] Ibid., May 1, 1858.
[4] Schneller, Arzneim. des Kindlichen Alters, p. 17.
[5] Bull. de Thérap., lxiii. 491. [6] Lancet, Feb. 1870, p. 228.

In pharmacy sugar is extensively employed to prevent the decomposition of vegetable substance (conserves, confections), and the oxidation of metallic preparations, as in the case of the syrup of iodide of iron. It forms the excipient in many magistral and officinal preparations, such as powders, pills, and lozenges; in the form of syrup is also the excipient of an entire class of officinal preparations (*Syrupi*), and is added to many extemporaneous prescriptions for the purpose either of masking a disagreeable taste or of suspending an insoluble substance in water.

Class II.

ASTRINGENTS.

Astringents have been defined by Cullen to be "such substances as, applied to the human body, produce contraction and condensation of the soft solids, and thereby increase their density and cohesion." Boerhaave describes them as medicines "which cause the parietes of the bloodvessels to approach one another, close these tubes when open, increase the strength and rigidity of the fibres, and restore their firmness to relaxed tissues." The latter definition refers to an operation implied by the term *styptic*, which is commonly employed to designate medicines that control hemorrhage; but the words astringent and styptic are identical in original signification, the one being a Latin and the other a Greek expression of the same idea.

Astringents are derived from the vegetable and from the mineral kingdoms. Those of the former class agree in containing tannic acid associated with various bitter and other principles, while the latter consist chiefly of metallic salts.

The difficulty of explaining the modus operandi of medicines is nowhere more manifest than in what relates to this, one of the simplest of the classes into which they are divided. No effects are more evident and tangible than those of astringents, but none are less understood. When an astringent substance is taken into the mouth, it instantly causes a sensation of constriction and puckering of the tongue, lips, cheeks, and gums, a sensation so familiar and so primary in its nature, that no other word describes it so well as *astringency*. With this sense of puckering is associated one of stiffness and dryness of the affected parts, and if the preparation be a strong one, as a concentrated solution of tannin, it operates as an irritant, occasioning pain. The latter effect is more marked when the application is made to the mucous membrane of the eye or of the nasal fossæ, and is followed by a profuse secretion from the adjacent membrane and from lachrymal glands. When astringents containing tannin are taken into the empty stomach, and in large, doses, they are apt to occasion nausea and eructation. If the sensibility of the stomach is morbidly increased, pain may ensue, and as experiments upon animals prove, even a caustic effect may result.

When these substances are administered during the process of digestion, it is materially interfered with in consequence of the precipitates which they form with albumen, casein, and the gastric juices. Their ulterior influence upon the stomach displays itself in impaired appetite and digestion, gastric pain and even vomiting, and as a consequence of these effects, emaciation and debility.

The generally received opinion is that astringents produce constipation, but although they certainly diminish the secretions of the intestinal canal, they do not appear to restrain the peristaltic movements of the bowel. Such was the result of Hennig's experiments upon himself, on cats, and on frogs,[1] and although Cavarra, as elsewhere stated, asserts that tannic acid in doses of two grains and a half produced obstinate confinement of the bowels, Dr. Tully declares that he took ten grains of pure tannic acid four times in the twenty-four hours, and continued these doses for about a week, with no more constipating effect than if he had taken so much maize meal.[2] A similar trial with identical effects was afterwards made by several professional pupils of Dr. Tully. The article excited a little nausea, however, and impaired the appetite considerably. This distinguished physician also assures us that he often administered tannic acid in doses of a heaped teaspoonful, at short intervals, till it began to disturb the stomach, in cases of hemorrhage from the lungs for example, and without any constipating effect. It may be objected (and the objection appears to be not without weight), that in these experiments the quantity of the medicine taken was sufficient to irritate the bowel, and that thus its desiccative operation was neutralized or more than neutralized. This appears the more probable, since we find that no mention is made of dryness of the dejections, such as Cavarra, and also Hennig, invariably found.

The manner in which the constringing and drying operation of astringents is performed, is not regarded in the same light by all who have examined the subject. According to some, it is explained by the coagulation of albumen, which all astringents produce, and the precipitation of gelatin, which is strikingly effected by tannic acid. But such processes cannot be supposed to take place in the living body. Mr. Headland, recognizing the validity of this objection, assumes that astringents act directly and especially on muscular fibre, causing this "to contract, whether it be striped and voluntary, or of the involuntary unstriped kind."[3] Taken into the blood in a state of solution, he supposes them to pass through the walls of the capillaries to the muscular tissue, and to stimulate to contraction the unstriped muscular fibres existing in the middle coat of the arteries, in the walls of the capillary vessels, in the lining of the ducts of glands generally, in the substance of the heart, and in the coats of the stomach and intestines. It need hardly be said that this view, however well it may be adapted to explain the phenomena occasioned by astringent medicines, is a purely gratuitous

[1] Archiv für Wissenschaft. Heilkunde, i. 697.
[2] Materia Medica, or Pharmacology, i. 1112.
[3] The Action of Medicines, p. 244.

theory, and might be predicated of tonic, and, indeed, of other classes of medicines, as well as of astringents. In regard to mineral astringents which evidently exert their power of coagulating albumen and fibrin, when applied upon secreting or bleeding surfaces, it is quite as difficult as in the case of tannic acid, to understand in what manner they can retain an astringent power while passing through the blood. We do indeed know, that in some manner this power is retained, for we constantly see it exercised by the acetate of lead, the salts of iron, etc. But to suppose, with the author just quoted, that these substances "are constrained by various forces" to suspend their natural tendencies so long as they are in the blood, and that on their exit by secretion from this fluid they resume their original activity, is simply to substitute an hypothesis for an obscure fact, and, perhaps, to deter from investigation where inquiry is most needed.

In regard to the local action of astringents, there is much plausibility in the view which is taken by Hennig. This experimenter remarks that a strong solution or a powder of tannic acid does not impress the nerve of taste in as great a degree as a weaker preparation, because the latter penetrates the epithelium, and therefore affects the gustatory nerve more readily. The sense of astringency he ascribes to the strong affinity of the astringent substance for water, which, therefore, it abstracts from the membranes and papillæ, corrugating the superficial layers of the epithelium, and causing them with "the parasitical capillary fungi" on their surface, to be thrown off. Hence the more newly-formed epithelial layers are laid bare, and, if the tannic acid is renewed, it penetrates and desiccates the subjacent tissues. Hence, also, instead of being stimulated, the muscular layer is deprived of its freedom of movement, and becomes rigid. At the same time the surface to which the solution is applied, loses its polish. If a very strong solution of tannic acid is used, the sense of taste may be temporarily quite lost, the nervous substance becoming disorganized, and the mucous membrane likewise. But the very energy of this action limits its extent; the constriction of the superficial parts is so great, and their hardness is so much increased by the coagulation of albumen interstitially effused, that the penetration of the astringent liquid is arrested.

Considering the results of experience in the use of tannic acid, there appear to be good grounds for doubting its efficacy as an astringent except when it is locally applied. Otherwise it is certainly inferior to the mineral astringents. Nor is there any reason for attributing to it a tonic property, which some have done from witnessing the effects of certain vegetable medicines which yield this substance; for such medicines also contain bitter principles upon which, doubtless, their tonic properties depend. It does not follow that pure tannic acid is always to be preferred for internal administration as an astringent. On the contrary, the tendency which, in large doses, it shows to derange the digestive function, suggests the propriety of prescribing it in its natural

association with bitter tonics whenever a prolonged use of it is required.

Each of the several astringents has powers which are peculiar to itself, and they can by no means be substituted for one another so as to produce identical effects. Nitrate of silver and sulphate of copper excel vegetable astringents in consolidating ulcerated tissues, but preparations of tannin, or rather of some of the astringent barks, are far superior to these mineral remedies in preventing that softening of tissue which tends to terminate in ulceration. The first named articles are also better adapted, as a general rule, for internal administration. Creasote, nitrate of silver, and nitric and other strong acids, are more efficacious as styptics than tannic acid. Except creasote, they are also caustics. Several astringents also possess specific powers of a totally different nature. Lead, for example, in some of its forms, has a special direction to the nervous system, and in one combination it constitutes a powerful deodorizer. Iron, which in certain of its compounds, as the perchloride, is eminently a styptic, is a tonic in its general operation. The sulphates of alumina, copper, and zinc, are emetic as well as astringent, and the second is supposed to have some antiperiodic influence, while the last is employed in the treatment of neuralgia.

From the above statement of the operation of astringent medicines it will be inferred that they have been found useful both internally and externally, whenever a laxity of tissue exists alone, or at the same time favors an undue discharge of blood or other animal liquid, or when this or a more active cause occasions its stasis within the affected part.

External Use.—Relaxation of tissue is a frequent consequence of debility either original or acquired. The former is observed in young persons of a lymphatic constitution, and especially in females, and is manifested by weakness of the joints, swelling of the ankles, a pendulous condition of the mammæ, and a general flabbiness of the skin. In such cases general baths and lotions containing vegetable astringents have been found to impart tone to the enfeebled tissues. Gargles or lotions of the same composition are in common use to correct atonic œdematous swelling of the fauces, or simple relaxation of these parts, of the vagina, or of the rectum; or else the more powerful stimulus of mineral astringents is resorted to for the same purpose. A tendency to passive inflammation and gangrene of the skin, subjected to pressure by the posture of the patient or otherwise, is often met with in protracted sickness accompanied with great debility, and such effects may sometimes be guarded against by hardening the integument by means of the substances in question. If disorganization have already commenced in the cases alluded to, or if, from other causes, such as an epidemic influence, accidental wounds or wounds made by the surgeon's knife betray a tendency to gangrene, the desiccative power of astringents, and especially of powdered cinchona or oak bark, is immediately manifested, the affected parts become firmer, and their offensive odor is neutralized. The pulverulent form of the application is

not without its influence. In these cases, also, some medicines, ranked usually with astringents, such as creasote and nitrate of lead, produce, at the same time, a deodorizing effect.

Astringent medicines are powerfully antiphlogistic in their local operation. Inflammation implies congestion and effusion, and astringents, by their action upon the tissues, exclude the blood, and consequently prevent the ulterior changes which its presence would induce. But it is essential to the success of their operation that it should not be interrupted; for at every suspension of their repressive action the blood rushes with augmented volume into the irritated part, and resists the power of the medicine to dislodge it. Hence, in the forming stage of inflammations, unless the astringent action can be steadily sustained, it had better not be invoked at all. It is, therefore, an ineligible mode of treating the first stage of local inflammation involving the eye, the fauces, and in fact any of the accessible mucous membranes. Indeed, even if the astringent substance could be maintained in these situations, it would generally be found that the morbid sensibility of the part would be aggravated by its contact. It is true, however, that when such applications are made at a low temperature, this effect is modified, and may even be neutralized, especially if the contact with the inflamed tissue is not immediate; as when compresses wet with lead water, or when alum curd is applied over the eyelid in the forming stages of conjunctivitis. It is in purely local inflammations of parts covered by the skin, and above all in those of a traumatic origin, that astringent lotions are most useful, and especially in sprains, contusions, etc., provided the application be made directly after the injury. In this case the morbid process may be arrested in its forming stage; but when once effusion has taken place the measures in question tend only to prolong and even to perpetuate the debility of the part, because they impede the curative operations of nature in removing the effused and now consolidated liquids. In the decline of the inflammatory process, however, when active movements have ceased, and the parts are affected with atony rather than excessive action, astringents may be appropriately resorted to for the purpose not only of strengthening the relaxed tissues, but also, in some cases, by a direct stimulant action, of promoting the absorption of the effusion, and thus restoring the part to its normal dimensions and activity. Some care must be exercised, however, lest the prolonged use of these measures should interrupt the nutrition of the tissues, and induce their atrophy.

But there are many cases in which inflammation of the integument, or of the subjacent parts, is neither traumatic, nor, even when spontaneous, strictly local. There are many eruptions of the skin which are signs of an internal and constitutional disorder, and are even indications of an attempt on the part of the economy to rid itself of some noxious ingredient of the circulating fluid. Syphilitic eruptions are of this sort, and are never benefited by a repercussive treatment. The same is more or less true of all the exanthemata. Repressive means are, perhaps, never attempted in any of

these, except erysipelas; but even in this affection, when idiopathic, the method is nugatory when it is not also full of danger. A partial exception to this statement is to be found in the use of astringent or constringing applications to the face in smallpox to prevent pitting. Even in those diseases of the skin which are not specific, but which yet are often dependent upon some hereditary or acquired vice of the economy, it is seldom desirable to attempt a cure by the means in question, for, apart from its probable failure, it is exposed to the risk of arresting the external disease at the expense of some internal organ more essential to life than the skin. The latter remark is quite as applicable to the question of curing an ulcerated surface which has long furnished a purulent discharge. To do so is never free from peril, and it is peculiarly hazardous when the patient is of a plethoric constitution, or inherits a tendency to apoplexy, phthisis, or other serious internal disease.

Among the occasions for an external use of astringents must be mentioned hemorrhage, both spontaneous and traumatic. But while the former, depending, as it does, either upon the constitution of the blood, or upon the energy of the circulatory forces, is comparatively less amenable to local influences, the latter is often maintained either by the nature of the wound or by other causes not so appreciable. It is in this, however, that styptic applications are of the greatest use, by coagulating the blood even within the bleeding vessels, and thus gradually arresting their loss. It should not be forgotten that the operation of the styptic ought always to be sustained by mechanical means.

Internal Use.—It has already been seen that astringents are constantly employed as local agents to correct debility and laxity of the external integument, and of the mucous membrane immediately connected with it. They are scarcely less frequently resorted to in analogous conditions of the lining membrane of the gastro-intestinal canal, and even of the urinary organs and other parts that are most conveniently reached through the channel of the circulation.

Astringent medicines are of common use in the treatment of gastric debility accompanied with indigestion and flatulent distension of the stomach and bowels, but seldom or never in their state of pure astringency. Tannic acid, so far from exerting a beneficial influence on such conditions, tends only to aggravate them; but when this substance, in its natural association with bitter tonics, is appropriately administered, the tone of the affected organ is gradually restored. Even in that disorder known as gastrorrhœa, or gastric flux, a pure astringent is of little avail, while a medicine that is stimulant and tonic, as well as astringent, is most appropriate to the cure. Indeed, it appears to be very probable that whatever benefit may accrue from the use of mere astringents in chronic gastric disorders, is more than counterbalanced by the mischief they occasion in preventing a due secretion of the acid juices of the stomach and of the bile, fluids which are essential to good digestion. The more common disorder, intestinal flux, is very often treated by means of astringents, and often very improperly. Diar-

rhœa is nearly always due to one of the following causes: irritants in the bowel, inflammation or other disease of the latter, or a depurative operation for the elimination of some morbid element from the economy. Of these causes the only one which tolerates the use of astringents for curing the resulting diarrhœa, is a form and degree of inflammation unaccompanied by any active symptoms such as pain, tenderness, and fever. To administer these medicines when the intestine contains irritating ingesta, or when the flux tends to relieve congested organs, or when the blood is charged with effete and poisonous materials, is to prolong disease and even to endanger life. In the first of these cases astringents become safe remedies only after the bowels have been purged of their irritating contents, and even then those forms of administering them are best in which they are associated with aromatic stimulants or with opium. In the other affections referred to, astringents are never useful during the active stage, unless it be to check an excessive evacuation of the fluids, and even in that case opiates are usually to be preferred. In the treatment of cholera morbus, the latter remedies are infinitely more efficient than the former, and usually suffice to effect a cure. Even in epidemic or pestilential cholera, when fully formed, the only astringents which appear to be at all useful are mineral acids and the acetate of lead, and these, as it has been already remarked, are far from exercising a simple astringent operation. But these medicines, and chalk, except during the premonitory diarrhœa, and in the decline of the attack, are of comparatively slight utility. In acute dysentery, which on several grounds appears to be more than a simple inflammation, astringents are often administered imprudently, with the effect of directly aggravating the disease; or, if they do not inflict this injury, they tend to establish an irritation of the bowel, indefinitely prolonged by their promoting the formation of scybala. These remarks, which are true of simple astringents, are somewhat less applicable to acetate of lead, which, on account of its sedative action, is not contraindicated by the febrile symptoms of the disease. Yet the condition of the fecal matters just alluded to results from the use of this as well as of the other remedies of the same class, and ought therefore to be guarded against by avoiding the premature or the too lavish use of them.

In *passive hemorrhages*, due either to a diseased condition of the blood, or to an atonic state of the solids generally, or of some particular organ, astringent medicines are frequently employed, and with signal advantage. It is true that they may not, and the pure astringents certainly do not, permanently counteract the cause of the hemorrhage; but it is often an important object to check the loss of blood and the failure of the strength, until the remote cause of the hemorrhage is removed by appropriate means. The modes by which astringents fulfil this indication are probably various; some, and those of vegetable origin in particular, appearing to act rather by a constringing influence upon the capillary bloodvessels than by any direct modification of the blood; others, as the muriated tincture of iron, and still more, the perchloride of that metal, certainly

produce coagulation of the blood when it is discharged; the acetate of lead seems to exert a coagulating power indirectly by its sedative action on the heart, as is seen in the treatment of aneurisms by its use. If we admit, however, that astringents are capable of coagulating the blood within the vessels, it is difficult to understand why they should exert this power upon the particular bloodvessels which are the seat of hemorrhage, and not equally upon all those in the body. That they have not the latter effect is evident, because it would be incompatible with life. To suppose, as is commonly done, that these medicines increase the coagulability of the blood, is an assumption not founded upon sufficient facts. Indeed, all that we know of their direct influence upon the blood is inconsistent with this supposition. Mitscherlich, having partially immersed frogs in a solution of tannic acid, so that their blood became impregnated with it, found that the circulating fluid grew darker in color, coagulated more slowly than usual, and formed an imperfect and pasty clot. So far as this experiment, which was also performed by Hennig, may be regarded as authoritative, it expressly discredits the idea that astringents exercise any condensing power on the constituents of the living blood. It is more consonant with experience to conclude that, when given internally, they control hemorrhages by the constringing influence which they exert upon the solids.

In this manner, also, it is conceived, astringent medicines are sometimes useful in moderating fluxes from the skin, lungs, kidneys, bladder, and uterus. It is worthy of remark that pure vegetable astringents (tannic acid) are most potent in controlling colliquative sweats; they are less so, yet not inoperative, in chronic bronchial flux; while in most of the other cases mentioned, mineral astringents are decidedly to be preferred. Yet, in catarrh of the urinary organs, several vegetable astringents (uva ursi, pipsissewa) are used with advantage, in all probability, because in them the astringent principle is associated with a stimulant, or a saline ingredient, which renders the medicine diuretic.

FRIGUS.—*Cold.*—Vid. *General Sedatives.*

MINERAL ASTRINGENTS.

ACIDA MINERALIA.—*Mineral Acids.*—Vid. *Irritants.*

ALUMEN.—ALUM.

ALUMINII ET POTASSII SULPHAS.—SULPHATE OF ALUMINIUM AND POTASSIUM.

Description.—The U. S. Pharmacopœia recognizes two forms of alum, ammonia alum and potassa alum. Potassa alum is a sulphate of aluminium and potassium, consisting of one equivalent of each of these salts, and twenty-four equivalents of water. It occurs native in the neighborhood of some volcanoes, and in coal formations, but is usually the product of the direct combination of its elements, or of the calcination and lixiviation of alum stone, a mineral formed in lavas and trachytic rocks by the rise of sulphurous vapors. It is also obtained by exposing to heat and air an alum slate or alum earth, in which the bisulphuret of iron is converted into an oxide of iron, and sulphate of aluminium is formed, which, on being lixiviated, combines with the sulphate of potassium in the ashes of the solution, and alum is produced. Ammonia alum is made by adding sulphide of ammonium to a solution of sulphate of aluminium. The two salts cannot be distinguished by simple inspection.

Alum crystallizes in octohedral crystals and sometimes in cubes, but, as usually found in commerce, it is in irregular masses with an obscurely crystalline surface. It is transparent or translucent, effloresces slightly, is inodorous, and has a strongly styptic and astringent taste. On being heated, its water of crystallization is given off with fusion of the mass and ebullition, and a white dry spongy mass results which is called *burnt alum*, and is styptic in a high degree. This preparation was formerly officinal under the name of *Alumen exsiccatum*, or *dried alum.* Alum dissolves in fourteen or fifteen times its weight of cold, and less than its own weight (0.75 parts) of boiling water, and is insoluble in alcohol.

History.—Beckmann has attempted to show that στυπτηρία of the Greeks, or its equivalent, *alumen* of the Romans, was not our alum, but rather a sulphate of iron, copper, or zinc. He is of opinion that alum was first brought into Europe from the East in the twelfth century, and that the oldest alum works in Europe were established about the middle of the fifteenth century.[1] Mr. Adams, however, dissents from this opinion, on the ground, that, as alum

[1] Hist. of Inventions, 2d ed., i. 288.

abounded in Greece and Italy, it must have been known to their inhabitants, and it is not pretended that it was ever called by any other name. Other critics entertain similar views.

Three varieties of alum (στυπτηρία) are distinguished in the Hippocratic writings, where a solution of it in white wine with pomegranate skins is recommended as an enema, and for preparing a suppository for prolapsus ani; a cataplasm containing it and moistened with vinegar is advised for irritable, inflamed, and sordid ulcers, and burnt alum in ulceration of the womb.[1] Dioscorides describes three varieties of alum. He says that it is heating and astringent, represses fungous granulations, stanches hemorrhages, hardens spongy gums, with honey cures ulcers of the mouth, is useful in otorrhœa, and, dissolved in an infusion of cabbage, or mixed with honey, is beneficial in various cutaneous affections. It is of service to reduce all swellings of the gums, tonsils, and soft palate, and is applied with honey to the mouth, the ears, and the genital organs.[2] Celsus makes several allusions to alum, as an application to ulcers produced by cold, and to fistulous sores, and as an escharotic for certain tumors (myrmecia) of the hands and feet.[3] To the accounts given by his predecessors, Pliny does not add much, except that alum acts internally as a hæmostatic, and that it is used in enemata for the cure of dysentery.[4] The native practitioners of India prescribe alum occasionally in cases of chronic diarrhœa, diabetes, and fluor albus, and externally in ophthalmia.[5] Aretæus particularly recommends, in malignant sore throat, that powdered alum should be blown upon the ulcerated part through a quill or reed, or applied mixed with honeyed water.[6] He recommends it, also, for internal hemorrhages, and to arrest bleeding from the nose. Alum is said also to have formed a principal portion of the treatment for the epidemic malignant anginas which prevailed in Europe from the end of the sixteenth to the middle of the seventeenth century.[7]

Action.—The primary local action of alum is that of an astringent; it turns the part pale to which it is applied, by producing a contraction of all its fibres, including those of the bloodvessels, and, in the case of mucous membranes, it also renders them dry by diminishing their secretion. In this manner its direct action upon the intestinal canal is productive of constipation. According to Mitscherlich, and also Mialhe, a chemical action then ensues, and the alum enters into combination with the secretions of the part, and ultimately, if these fail, with the tissue itself, upon which it acts as an irritant or caustic. If this action is sustained and prolonged, the ultimate effect of the medicine may be to increase the secretion of the part instead of diminishing it. Such an effect is familiarly observed when alum is administered internally; it soon

[1] Mat. Med. of Hippocrates, DIERBACH, p. 246.
[2] Mat. Med., lib. v. cap. lxxxii.
[3] GRIEVE'S CELSUS, 3d ed., pp. 276, 281, 285.
[4] Hist. Nat., lib. xxxv. cap. lii.
[5] Materia Indica, i. 11.
[6] Works, Syd. Soc. ed., pp. 409, 423, 460.
[7] BRETONNEAU, Arch. Gén., xiii. 14.

ceases to confine the bowels, and, indeed, as will be seen hereafter, it is actually used to overcome one of the most obstinate forms of constipation, that which depends upon lead poisoning. Mialhe refers to an example of the same sort furnished by the treatment of leucorrhœa with alum injections. Moreau states that these at first diminish the discharge, but if they are strong and long continued, they increase it. Mialhe mentions the case, also, of a person in whom the continued use of alum gargles induced copious ptyalism, and he thus endeavors to explain the effect. "When a very small quantity of alum, either in solution or not, is brought into contact with a mucous membrane or the denuded cutis, it is decomposed by the alkaline liquids of the part, forming a subsalt of alumina and potassa, and producing coagulation and constriction. But if a larger quantity of alum is then employed, not only is the original coagulum dissolved, but all the albuminous liquids of the economy, which have become saturated, as it were, with alum, become so fluid, as to pass readily through the tissues which are now no longer constringed. If, then, we desire to exert only a local constringing action, we should use but a small proportion of alum; but if, on the contrary, we seek to increase the activity of a part and render the humors more fluid, the medicine should be applied in large quantities."[1] In this chemical explanation of the increased discharge which follows the long-continued application of alum to a secreting surface, its irritant action appears to be overlooked, and this, it may fairly be presumed, by repetition excites the discharge in question.

The familiar facts of practical medicine render it certain that when alum is taken into the stomach it is absorbed, and modifies the blood, and probably, also, the contractility of the animal fibres. But it is also found in the urine of persons who use it, and in the liver, spleen, and other organs of animals to which it has been given in large quantities.

It appears from Orfila's experiments, that the smallest and the feeblest dogs have taken enormous doses, even two ounces, of calcined alum without any other symptoms than vomiting and purging: but if vomiting is prevented by ligation of the œsophagus the animal dies in a few hours, after exhibiting great debility and prostration. In the case of rabbits, used by Mitscherlich in his experiments, the result was different; two drachms of alum in solution proved fatal. In all the experiments which terminated fatally, the mucous membrane of the stomach was strongly inflamed, and in some cases erosions existed.

In man large doses of alum produce a sense of constriction in the fauces, and an unpleasant sensation in the stomach followed by vomiting, and sometimes by colic and diarrhœa. A drachm is usually sufficient to produce vomiting in a child under five years of age, but much larger doses have been taken as a remedy for intermittent fever, or otherwise, by adults without any other effect than

[1] Chimie Appliquée, p. 528.

transient nausea. There is no case on record of death, or even of material inconvenience, from the internal use of this medicine, in any dose, by a person previously free from serious disease. It is very possible, however, that if from insensibility, or any other cause, the alum were not vomited, it might occasion grave lesions of the stomach.

Uses. *Internally.*—Alum has probably been more employed for its styptic qualities than on any other account. Both ancient and modern physicians have recognized them. Even the sceptical Cullen admits that he often found it useful in *menorrhagia* and other uterine hemorrhages, but not in hæmoptysis, which exception he explained by saying that the latter is usually active while the former are more frequently passive.[1] It would have been more exact to state that alum, like every other hæmostatic medicine, is most useful when the *molimen hæmorrhagicum* is weak than when it is strong, for as such medicines arrest hemorrhage by creating a physical barrier to the escape of the blood, they are necessarily most efficient when the tendency of the blood to escape is feeblest. In hemorrhage from the *stomach*, the effects of the medicine will depend much upon the source of the effusion. If it be a passive exudation, the direct operation of the alum must be beneficial; if an active discharge from the erosion of a bloodvessel, or otherwise, the combined emetic and styptic action of the medicine would appear to be peculiarly indicated. Its operation may be promoted by ice given internally after emesis has ceased, and by iced applications to the epigastrium. In hemorrhage from the *bowels*, the tendency of large doses of alum to act upon the whole intestinal tract renders it more appropriate than the metallic sulphates. It has been found efficient in *hæmaturia*, whether the bleeding had its source in the kidneys, the ureters, or the bladder. In some forms of blood disease it has been used with advantage to prevent hemorrhage. Thus, Mead recommended it alternately with Peruvian bark and sulphuric acid in the hemorrhagic form of smallpox.[2]

A Dutch writer, J. Grashius, is said to have first suggested the use of alum in *colica pictonum*. He published several examples of its beneficial effects. In imitation of him, Percival also administered it "in the slighter cases" of the disease, prescribing fifteen grains of alum every four, five, or six hours. The second or third dose, he says, seldom failed to mitigate the pain.[3] Various other persons have commended this plan of treatment, especially Kapeler, who maintains it to be more efficient and prompt than the purgative plan,[4] and Gendrin, who declares that in fifty-eight cases of painters' colic the remedy did not fail once.[5] Dr. Copland, who witnessed, and who vouches for the success of Kapeler, states that he employed alum with uniform success in several cases;[6] and

[1] Mat. Med., ii. 18.
[2] Works, p. 245. See, also, Dodd, Phil. Trans. Abridg., ii. 465.
[3] Essays, i. 405, 459.
[4] Arch. Gen., xvii. 370.
[5] Compend. de Méd. Pratique, ii. 427.
[6] Dict. of Pract. Med. (Am. ed.), i. 440.

Brachet, in 1850, reported that, after becoming dissatisfied with the old methods, he had recourse to alum, and treated with it more than a hundred and fifty patients without accident or disappointment. He prescribed from 90 to 120 grains, in a ptisan, to be taken during the day, adding to this 40 or 50 drops of laudanum, and if the bowels did not act by the third day giving a mild aperient.[1] More recently, Briquet, who treated fifty-seven cases, in the course of eight years, with alum and sulphuric acid, found that by this method the duration of the pain was nearly the same as in the treatment by purgatives, while the constipation continued somewhat longer. The convalescence, on the other hand, was more rapid. His method consisted in the daily use of two quarts of sweetened water containing a drachm of sulphuric acid, and also a drachm of alum. A grain of opium was prescribed at night, and sulphurous baths daily as long as they continued to stain the skin.[2] It should be mentioned that neither Tanquerel nor Grisolle attributes any great degree of efficacy to the alum treatment; but the proofs of its virtues which we have furnished are, we think, conclusive. The dose of powdered alum is from 60 to 180 grains a day, given in solution.

Another evidence of the value of alum in an analogous affection, is furnished by Mr. Aldridge's experience with it in cases of *habitual constipation* producing or produced by atony of the intestines. In the dose of from twenty to forty grains he found that it would often produce large and very solid evacuations. Associated with sulphate of magnesia it corrects the unpleasant taste of this salt, and its tendency to produce flatulence.[3]

Dr. W. Griffin, of Limerick, found alum superior to all other internal remedies for *gastralgia* in cases of this affection associated with neuralgia of the spinal nerves.[4] Sir J. Murray made use of it with complete success to cure the affection described by him as *catarrh of the stomach*, in which the patient vomits large quantities of glairy and viscid mucus. For this disorder he prescribed alum in the form of an electuary, in doses of from ten to twenty grains, three or four times daily.[5]

In chronic *dysentery* alum has sometimes been used. With sulphate of zinc, cochineal, and water, it formed the vitriolic solution of which Moseley said he pledged the experience of many years that it was the best remedy he was acquainted with in this and similar affections.[6] A case of chronic dysentery was cured with alum by Dr. Leib, of Philadelphia, in 1789.[7] It has also been employed in acute dysentery. Adair states that he used it early and boldly, found it sedative and antiseptic, in a large dose laxative,

[1] Br. and For. Med.-Chir. Rev., Jan. 1851, p. 46.
[2] Bull de Thérap., liii. 97. [3] Braithwaite's Retros. (Am. ed.), xii. 82.
[4] Révue Med., xxxviii 399; and Observations, etc., on the Spinal Cord. Lond. 1831.
[5] Braithwaite's Retros. (Am. ed.), xix. 313.
[6] On Tropical Diseases, 4th ed., p. 401.
[7] Trans. College of Phys. of Philad., vol. i. 1793, p. 225.

and altogether the safest astringent he had tried.[1] In the same form of disease Hanon made use of injections of a solution of alum, each enema containing from 10 to 120 grains of alum, according to the age of the patient. He states that its administration promptly afforded relief, and was followed by a speedy cure.[2]

The astringent qualities of alum probably led to its being prescribed in the treatment of *diabetes*, first by Mead, and afterwards by Dover and Brocklesby, the last of whom reports a case apparently of the saccharine form of the disease, which was cured by alum whey.[3] Cullen, however, employed it without success.

It is well known that large doses of alum excite vomiting, and, as has been seen, when the œsophagus of an animal is tied after the administration of a large quantity of alum, death ensues, and inflammation of the gastric mucous membrane is found on dissection. This irritant property of alum might class it among the mechanical emetics along with the sulphates of copper and zinc. Dr. Charles D. Meigs, of Philadelphia, was the first to make use of this property in the treatment of membranous and also of spasmodic croup, and his example has been followed by many practitioners. In the latter disease a sedative influence rather than an expulsive effort is required, and hence the nauseant emetics are most beneficial in its treatment; but in *pseudo-membranous laryngitis* the strength of the patient must be taxed as little as possible, while medicines are given which excite the mechanical act of vomiting. Sulphate of copper is one of these, and has been used in a great many cases with the happiest result. Alum is probably next in value of the class of emetics referred to. Dr. J. F. Meigs says, respecting its use in true croup, that it possesses the advantage of being certain and rapid in its action, and of operating without producing exhaustion or prostration beyond that which always follows the mere act of vomiting. Dr. Meigs gives it in powder, in teaspoonful doses mixed with honey or syrup, and repeated every ten or fifteen minutes, until it operates. It is very seldom necessary to give a second dose to produce vomiting. It may be repeated twice or three times a day for two or three days, without any bad effect, and also with undiminished activity.[4] These are, certainly, strong inducements to the employment of alum in a disease so grave and alarming as membranous croup, especially as, in conjunction with mercurials, emetics form the safest basis of treatment. In cases where we have used it, unhappily without ultimate success, its emetic virtues were signally displayed.

In other cases where a powerful emetic effect is required, and the use of sedative emetics involves danger, no agent is more efficient than alum. It seems to be peculiarly adapted for use in *poisoning by narcotic substances*. In a case in which an ounce of powered opium had been taken two hours before, and thirty grains of sulphate of zinc had been given without producing emesis, half an

[1] DUNCAN's Comment., ix. 210.
[2] Bull. de l'Acad., xxxii. 1011.
[3] Med. Obs. and Inq., iii. 279.
[4] Diseases of Children, 2d ed., p. 96.

ounce of powdered alum, followed by two or three tumblers of warm water, caused copious vomiting to take place. After a short interval, a like quantity of alum was administered, free vomiting was renewed, and the patient recovered.[1]

In *bronchial affections* alum is sometimes of signal advantage. This was long ago insisted upon by Moseley in describing the effects of his *vitriolic solution*.[2] His language is so positive that we feel constrained to quote it. The solution, he says, "is of great utility in all pulmonic oppressions where respiration is performed with difficulty; and where expectoration is to be promoted, in nauseating or slightly vomiting doses. In most pituitous habits, with phlegmatic asthmas, in catarrhal coughs, and above all, in the moist English *hooping-cough*, its effects are wonderful; taken once or twice a day, particularly in the morning fasting, in doses to cause a slight retching. In the same manner it removes defluxions on the lungs, bronchia, and trachea, from relaxation of the parts or defect of their powers."[3]

It is not easy to understand why so efficient a remedy for an intractable complaint should have fallen comparatively into disuse. There are recent attestations of its efficacy, however, which may here be cited. As it has been seen, Moseley used and eulogized alum as a remedy for hooping-cough more than half a century ago. Subsequent authors, until quite recently, appear to have neglected it; but in 1844, it was recommended by Dr. Andrews and by Dr. Golding Bird.[4]

Dr. F. L. Andrews states that in acute as well as in chronic *bronchitis*, and both in children and adults, when the expectoration is ropy he used alum with the greatest benefit. To children three years of age he gave one grain in solution every five or six hours, and to adults six or eight grains at like intervals.[5] It was by no means the intention of either of the gentlemen named to propose the medicine as a specific, but only as an appropriate and efficient remedy in the nervous or spasmodic stage of the attack, when there is a copious secretion of viscid mucus in the bronchia. Dr. Bird prescribed it extensively during a period of three years, and he declared that he had not met with any other remedy which acted so satisfactorily or gave such marked and often rapid relief. The formula used by him was the following: ℞.—Aluminis, gr. xxv; Extracti conii, gr. xij; Syrupi rheados, ʒij; Aquæ anethi, ℥iij; m. capiat coch. i. med. 6tâ quâque horâ. It never produced any inconvenient astringent effects on the bowels; on the contrary, in more than one instance it occasioned some diarrhœa. Dr. Davis has also said: "After a long trial, I am disposed to attach more importance

[1] C. D. Meigs, Trans. of Col. of Phys. of Philad., N. S., ii. 47.

[2] The formula for the solution is thus given: ℞.—Zinci sulph. ʒiij; aluminis ʒj; pulv. cocci gr. iij; aquæ bullient. Oj. Reduce the ingredients to a fine powder, and gradually add the water until they are dissolved. When cold, filter the solution. *Dose.*—To create a slight retching, for an adult, a tablespoonful; for a child, six months old, a teaspoonful.

[3] Op. cit., p. 558.

[4] Guy's Hospital Reports, 2d ser., No. v. p. 139.

[5] Lancet, March, 1844, p. 42.

to alum as a remedy in hooping-cough than to any other form of tonic or antispasmodic."[1] To these evidences of the efficacy of the medicine we may add that of Dr. J. F. Meigs, who, after administering it in sixty-eight cases, says: "It has exerted a more decided influence in moderating the violence of the disorder than any medicine that I have ever made use of."[2] In a few cases in which we have employed it to lessen the bronchial secretion, it has appeared to have a very decided and happy effect. Whether it shortens the disease as much as it mitigates its severity, is not yet, we think, determined.

Alum was at one time much used in *intermittent fever*, it having been recommended by Ettmüller, Lind, Müller, and others. Lange and De Meza prescribed it with aromatics, and sulphuric acid or ether.[3] Adair found the addition of alum and canella to bark very effectual in the cure of quartan agues.[4] Boerhaave alludes to its use, and Van Swieten mentions that it is a custom with the common people to give alum and nutmeg to persons with the ague.[5] Cullen found this combination a successful one. But before all of these, Geoffroy wrote, "Alum is by some reckoned a great specific in intermittent fevers,"[6] after calcination, solution in vinegar, and recrystallization. A knowledge of these facts may not be without service to some who meet with cases in which the preparations of bark lose their effect.

Alum has also been resorted to as a means of moderating diarrhœa in *typhoid fever*. Fouquier,[7] and also Barthez,[8] employed it for this purpose. In an epidemic of the disease at Vienna in 1832, it was found useful when given in doses of from two to five grains every hour. Finally, it has been recommended as an internal remedy for the cure of *aneurisms* by Kreysig and Dzondi, and by Sundelin in palpitation of the heart;[9] but of its efficacy in these affections there is neither proof nor probability.

Locally.—The styptic and constringent operation of alum is rendered practically useful in a great many cases of disease upon the surface of the body, or in parts readily accessible from without. The following are the principal disorders in which it may be prescribed.

Hemorrhage. Before the present century alum was in general use as a styptic even in cases of traumatic hemorrhage, and was also habitually employed in hemorrhage from the nose, mouth, anus, vagina, etc. In uterine hemorrhage solutions of alum were injected into the womb by Riverius and Leake, and a sponge saturated with a strong solution of the salt was introduced by the latter into the vagina. Fabricius Hildanus describes a tampon containing finely-powdered alum as being used under similar circumstances.[10] Bleed-

[1] Am. Journ. of Med. Sci., July, 1847, p. 218.
[2] Diseases of Children, 2d ed., p. 223.
[3] COPLAND'S Dict. (Am. ed.), i. 1097.
[4] DUNCAN'S Comment., x. 233.
[5] Commentaries, vii. 284.
[6] A Treatise of the Substances made use of in Physick, 1736, p. 120.
[7] Bull. de Thérap., ix. 301.
[8] Arch. Gén. 3ème sér., v. 105.
[9] STRUMPF, Handbuch, i. 376.
[10] GMELIN, Apparat. Medic., Regn. Min., i. 118.

ing from leech-bites, from the jaw after the extraction of a tooth, and from similar situations, has been arrested by pressing upon the part a conical piece of alum, in the manner long ago recommended by Borelli and Diemerbroeck.[1] According to an ingenious suggestion of Dr. Wood, a dossil of lint or similar substance, saturated with a warm solution of alum, and allowed to cool in contact with the bleeding part, is the most efficient mode of making the particles of alum exert their astringent power.

Alum water, or brandy in which alum has been dissolved, may be used with great advantage to sponge the skin and moderate the *colliquative sweats* of tuberculous and other hectic diseases. This is an ancient practice, for it is mentioned by Aretæus,[2] and Dioscorides prescribed lotions containing alum to prevent the fetid secretion from the armpits and other parts, which is peculiar to certain persons.

Ophthalmia. Cullen refers to alum curd as being in common use as an application in ophthalmia, but says that he found the watery solution more effectual. This solution (saturated) is preferred by Mr. Jacob to that of nitrate of silver, which, if long used, discolors the membrane.[3] A weaker solution may be applied in cases of infantile ophthalmia. In 1832, M. Souty gave an account of the manner in which the natives of India treat purulent ophthalmia by means of alum mixed with the white of egg. The liquid, expressed from the mixture inclosed in a piece of muslin, is instilled into the eye every half hour if the inflammation is intense, and less frequently in milder cases, but is used in all stages of the attack.[4] Another East Indian method of using this remedy is described by Mr. Waring, as follows: "I can speak from experience of the efficacy of the following native application: Place some finely-powdered alum on a heated plate of iron, and, while the salt is in a state of fusion, add a small portion of lemon or lime juice, until it forms a black soft mass. This, while hot, is placed entirely round the orbit, taking care that none of it gets beneath the eyelids, as it causes, under these circumstances, intense agony. One or two applications, each being allowed to remain on for twelve hours, are sufficient in ordinary cases to effect a cure."[5] Alum curd is one of the best applications that can be made in ecchymoses of the eyelids, and of similar parts. It should be inclosed in a bag of cambric, or some analogous material, and renewed every three or four hours.

Aphonia, depending upon atony of the larynx, as indicated by paleness of the fauces and debility of the pharyngeal muscles, has been advantageously treated with alum gargles. Bennati, formerly physician to the Italian opera in Paris, found that a gargle, made by dissolving a drachm of alum in two ounces and a half of barley-water, and gradually increased in strength, was of essential service in restoring the natural tones of the voice. He combined with this application, however, sedulous attention to the general health, and

[1] Gmelin, Apparat. Medic., Regn. Min., i. p. 118.
[2] Morb. Acut., lib. ii. cap. iii.
[3] Cycl. of Pract. Med., iii 210.
[4] Arch. Gén., xxx. 116.
[5] Manual of Therapeutics, p. 23.

a regulated exercise of the voice.[1] Saucerotte found the internal administration of alum still more efficient than its use in gargles. He began by prescribing ten grains a day in divided doses, and gradually increased the quantity to forty-five grains.[2] Lozenges containing alum may be used to complete the cure, and also in milder cases of relaxation of the faucial mucous membrane.

Diphtheria and Tonsillitis. It has already been stated that Aretæus used insufflations of powdered alum in malignant inflammations of the throat. In modern times, its use is said to have been revived by Pommier, under the form of his *anti-croupal powder.* It was also used with great reputed advantage by Loffler.[3] But the remedy first became generally known through Bretonneau, who, during an epidemic of diphtheritic angina in 1827, applied a paste of alum and water to the affected throat with more success than any other remedy.[4] In 1828, Gendrin made use of powdered alum as an application to the throat in an epidemic of the disease, but judged it to be less efficacious than nitrate of silver.[5] In the same year, Guersent and Velpeau, and, in the following year, Giraudet, adopted the method of Aretæus, and employed insufflations of alum with marked advantage.[6] After some years' experience in its use, in 1835, Velpeau said that in all cases of *tonsillitis* it was wonderfully prompt in its effects, and, provided that an abscess had not formed, it cut short the inflammation "like magic." Trousseau, who had an opportunity of studying the epidemics described by Bretonneau, and also the disease as it appears in the hospitals of Paris, expressed a high estimate of the efficacy of alum in its treatment. When the diphtheritic affection is confined to the gums, a mouth-wash, made by dissolving alum in vinegar and water, is usually sufficient, and will sometimes effect a cure when other remedies have been vainly tried for months together. "When the false membrane forms upon the tonsils, a simple gargle will suffice to remove it if the patient is an adult; but in children, and when the deposit extends beyond the pharynx, insufflations of powdered alum are necessary. For this purpose a tube of any material can be used, and about a drachm of finely-powdered alum having been introduced into one extremity, the other end of the tube is carried into the back part of the mouth, and by a sudden and strong puff the powder is blown into the pharynx. The cries of the child afford an opportunity of accomplishing this purpose, which should be effected as much as possible during the act of inspiration. The operation, which should be repeated five or six times a day, always occasions vomiting and profuse salivation, but this disturbance subsides within a quarter of an hour, and it rarely happens that the gravest attack of diphtheria does not yield to this treatment in the course of four or five days, if the interior of the larynx is not affected. When the plastic deposit occurs upon the skin, upon the

[1] Bull. de Thérap., i. 265.
[2] Ibid., xxxviii. 360.
[3] Richter, Aüsfurl. Arzneim., iv. 232.
[4] Archives Gén., xiii. 14.
[5] Journ. Complément., xxx. 269.
[6] Archives Gén., xvii. 503; and ibid., xix. 586.

nipple, or the mucous membrane of the genital organs, alum lotions, frequently repeated, readily cure this so often formidable inflammation."[1] Louiseau and Trousseau advise the association of alum and tannin, or the alternation of these two substances with one another, and their application by insufflation, or by means of a sponge.[2] It is only too well known that the epidemic of diphtheria, which recently for several years existed in America and Europe, did not yield to this or any other local treatment, in cases which could be regarded as serious. Inhalation of the vapor of a strong solution of alum, and especially of an atomized solution, is of signal advantage in chronic *pulmonary catarrh*, and in similar affections of the *pharynx* and *larynx*.

Velpeau found powdered alum a very efficient remedy in an affection of frequent occurrence, and which, besides causing great pain, renders mastication impossible. It consists in an inflammation of the *gum* around the furthest molar tooth, particularly of the lower jaw. The swollen gum overlaps the tooth, the adjacent part of the cheek is hard and swollen, and the breath extremely fetid.[3] Burnt alum is, in this case, the most efficient form of the remedy. Mouth-washes and gargles of alum are serviceable in *mercurial ptyalism*. In that painful and often tedious affection known as *ingrown nail*, when the irritated parts have begun to ulcerate, and are covered with loose and flabby granulations, no better application can be made than burnt alum. It was used in 1823 by Sommé, of Antwerp, in the following manner. After applying a poultice for several days, and then removing with the scissors the portion of the nail imbedded in the flesh, he filled the cavity of the sore with the powdered alum, and renewed the application every day. It speedily dried up the discharge, and healed the sore if the patient refrained sufficiently from using the affected foot.[4] Recently the value of this practice has been established by the author's experience of thirty years in its use.[5] Stazi recommended the use of a powder consisting of equal parts of alum and white sugar to produce a more healthy surface in *foul wounds* and *ulcers*.[6] Indeed, wherever spongy or *exuberant granulations* are to be repressed, burnt alum may be depended upon as an efficient application. A solution of alum is among the most certain means of remedying the *relaxation of mucous membranes* resulting from inflammation or prolonged distension. Relaxation of the gums, uvula, and adjacent parts, of the vagina in consequence of childbirth or chronic leucorrhœa, of the sphincter ani permitting prolapse of the rectum, and similar conditions, are often remedied by this application. The ancients made use of it to strengthen joints that had been weakened by dislocation.

The alum lotion is said both to prevent and to cure *chilblains*. It is frequently a successful application in *pruritus vulvæ*, and is very efficacious in curing *leucorrhœa of the vulva*, a very common disease which sometimes occurs epidemically, especially among children

[1] Op. cit., 5ème éd., i. 156.
[2] Bull. de Thérap., liv. 378, and Annuaire de Thér., 1861, p. 149.
[3] Archives Gén., 2ème sér., vii. 564.
[4] Ibid., i. 485.
[5] Bull. de Thérap. (1852), xliii. 88.
[6] Practitioner, i. 129.

of the lower class who neglect personal cleanliness. As a remedy for *vaginal leucorrhœa*, alum is in very general use, and it is certainly one of the most successful of the remedies for this annoying and often recurring disease. A solution of 60 grains of alum to four ounces of cold water may be used twice a day, and the proportion of alum gradually increased. Gautier, of Geneva, made use, in the treatment of this disease, of the insufflation of finely-pulverized alum, or of the introduction of a roll of cotton-wool containing in its centre a teaspoonful of powdered alum, and, finally, of tampons covered with a mixture of lard and alum in equal proportions. He states that the first and second of these methods often cause so forcible a constriction of the vagina as to render the introduction of the finger very difficult.[1]

Finally, powdered burnt alum has been used successfully to promote the granulation and cicatrization of an extensive ulcer resulting from a *burn*.[2]

Toothache depending upon dental caries is said to be very often relieved by the method of M. Lefoulon, which consists in mixing together powdered alum, sulphuric ether, and a little mucilage, so as to form a paste, which is introduced into the cavity in the tooth. This application is renewed at first several times a day, and then less frequently, until the sensibility of the tooth is entirely destroyed.[3]

Administration.—Alum may be given *internally* in doses of from five to forty grains, and either in substance or solution. In the form of a fine powder, mixed with an equal proportion of pulverized sugar, or in molasses, it is taken without inconvenience. The addition of a few grains of cinnamon or nutmeg tends to correct its nauseating effects. If an emetic operation is desired, the dose of alum may be carried to 60 or 120 grains, or even more, while vemiting is promoted by copious draughts of warm water. In solution it may be given in sweetened aromatic water or in mucilage, with the addition of a small proportion of some preparation of opium.

Alum whey, which has been referred to above, is prepared by boiling 120 grains of powdered alum with a pint of milk, and then straining. The average dose is a wineglassful.

Alum curd, procured in the manner just described, or by rubbing together powdered alum and the white of an egg, may be applied to the affected part, covered with a piece of fine linen gauze.

Solutions of alum are made of various strengths, according to the object in using them. A gargle is made by dissolving from half an ounce to an ounce of alum in a pint of water sweetened with honey. In the ophthalmia of children, two or three grains to the ounce of water make a collyrium of sufficient astringency for a first application; on the other hand, to arrest hemorrhages a saturated solution in hot water is the best.

Burnt alum and pulverized alum are used as local applications in

[1] Rec. des Travaux de la Soc. Méd. de Genève, i. 232.
[2] Turner, N. Y. Med Journ., vi. 332.
[3] Trousseau and Pidoux, op. cit., i. 158.

the same cases. The greater lightness of the former renders it more appropriate for insufflations.

Sulphate of Aluminium and Sulphate of Aluminium and Zinc.—The simple sulphate of aluminium is very soluble in water, and has a very styptic taste, but on account of the free acid which it contains is an ineligible preparation. To correct this defect and improve its therapeutical application, it may be combined with zinc so as to form a double salt. This substance has an acrid, metallic, and disagreeable taste, and exerts a powerfully modifying operation upon organized tissues. In its pure state it acts as a caustic. Mixed with an equal quantity of glycerin its action is mitigated. It is recommended by Homolle as an application in hypertrophy and in pultaceous inflammation of the tonsils, in granular pharyngitis, mucous polypus of the nasal fossæ, ozæna, vesical and vaginal catarrh, ingrown toe-nail, scrofulous ulcers, displacements and ulcers of the uterus, vascular nævi, and cancerous and cancroid ulcers. In all of the above named affections the *benzoated solution of alum* is recommended by Bouchardat, as both efficient and innocuous. It contains more than one-half its weight of sulphate of aluminium saturated with gelatinous hydrate of alumina and the soluble constituents of benzoin.

BISMUTHI SUBNITRAS.—Subnitrate of Bismuth.

BISMUTHI SUBCARBONAS.—Subcarbonate of Bismuth.

Description.—Subnitrate of bismuth is prepared by adding a solution of freshly prepared nitrate of bismuth to a solution of carbonate of sodium, washing the precipitated subcarbonate with distilled water, and then treating it successively with nitric acid, distilled water, and water of ammonia. The last-named addition has for its object to neutralize any free acid which may be present. Guibourt states that in extracting bismuth from its ores, it ought to be melted a second time, and at a high temperature, to deprive it of arsenic, of which it always contains a portion, as well as of sulphur, zinc, lead, copper, and iron. For use in medicine, he adds, it should be still further purified by fusion with nitrate of potassa, which converts the arsenic into an arseniate of potassa. The latter, by its specific levity, separates itself from the metal.

Subnitrate of bismuth is a compound of one equivalent of nitric acid, one of teroxide of bismuth, and one of water. It is a dull-white, heavy powder of a faintly acid taste and smell, and is composed of fine acicular crystals. It is very slightly soluble in water, but is readily dissolved in weak acids.[1]

[1] This statement, made by standard authorities, is inconsistent with the alleged insolubility of bismuth in the digestive fluids: vid. *infra*.

Subcarbonate of bismuth is procured by the double decomposition of freshly prepared nitrate of bismuth and carbonate of soda in solution. It "is a white or yellowish-white powder, without taste or smell, insoluble in water, but soluble with effervescence, in dilute nitric acid."

History.—Bismuth was confounded by the ancients with tin and lead, and was first distinguished from them by Stahl. The subnitrate, formerly called the *trisnitrate*, and until 1802 the *white oxide* of bismuth, was originally prepared by Lemery, towards the close of the seventeenth century, as a secret medicine. The virtues for which it is now celebrated, are of comparatively recent discovery. Lemery himself speaks of its discutient and drying properties, and of its application in ointments and plasters.[1] Pomet mentions its use as a cosmetic and as a remedy for cutaneous eruptions.[2] Geoffroy says: "Some prepare flowers from it which they say are diaphoretic; but most physicians have been afraid to use it inwardly, because of the arsenical parts contained in it."[3] Much later, Alston states that it is but little used except as a cosmetic,[4] and Lewis, after remarking that it has been "recommended against gleeting sores, and internally as a diaphoretic," adds that it is now only employed as a cosmetic, and not always without injury to the complexion.[5] Of its internal use we have only the additional information that Pott had known it to occasion violent præcordial distress.

For the real introduction of subnitrate of bismuth into the Materia Medica, we are indebted to Odier, of Geneva, who published an account of its virtues as a remedy for gastralgia, in 1786.[6] Soon afterwards, Carminati and others confirmed his statements; but, in 1799, the medicine was stated to be "either neglected or forgotten," and how unjustly so, an example of its efficacy in "spasmodic pain of the stomach and bowels" was cited to prove.[7] In England it was introduced by Dr. Marcet, who learned its virtues from Odier,[8] and shortly afterwards Dr. Bardsley, of Manchester, added his testimony in its favor.[9] In this country its virtues were first made known in the Inaugural Dissertation of Dr. S. W. Moore, of New York.[10] In France, after having been used by Laennec, Guersent, and Bretonneau, and warmly advocated by Lombard, of Geneva, it was popularized by the encomiums of Trousseau, and especially of Monneret.

Action. *On Animals.*—The operation of this substance is far from being determined upon stable grounds. The results of experiments performed with it and of observations of its use in medicine, are often opposite and apparently irreconcileable. We shall endeavor

[1] Traité des Drogues Simples, p. 127. [2] Hist. gén., etc., 3ème part., ch. xlv.
[3] A Treatise of the Fossil, etc., 1736, p. 210.
[4] Mat. Med., ii. 332. [5] Mat. Med., 4th ed., i. 222.
[6] Gmelin, Apparat. Med., p. ii., i. 351.
[7] Lond. Med. and Phys. Journ., 1801, i. 511.
[8] Mem. Med. Soc. Lond., 1801, vi. 155. [9] Med. Reports, 1807, p. 218.
[10] Eclect. Report., i. 234.

to state these results fairly and succinctly. Orfila performed a number of experiments to test the action of the nitrate and of the subnitrate of bismuth. Among them were two in which the former of these substances was thrown into the veins, and the animals are said to have died in a state of exhaustion. In the other instances, the symptoms induced by the administration of either salt of bismuth, were vomiting, depression, debility, tremulousness, dyspnœa, and death. In every case the gastric mucous membrane was found inflamed, softened, and ulcerated. Orfila also states that nitrate of bismuth, administered by the stomach, could be detected in the liver and spleen, and in the urine.[1] Symptoms and lesions like those above described, were observed by Meyer of Bonn, in his experiments.[2] Headland affirms, on the other hand, that subnitrate of bismuth is as perfectly insoluble in the fluids of the intestinal canal as charcoal, the simple metals, or woody fibre.[3]

On Man.—Monneret states that he has given from two to six drachms of this medicine, in the course of a day, to children of from two months to two years of age, and never saw the slightest evil effects produced by it; and he elsewhere remarks: "The imaginary description presented by Orfila, of the effects of subnitrate of bismuth upon animals, must be stricken from among the facts of medicine."[4] This author, whose experience in the use of the medicine is probably unequalled, affirms that it occasions neither thirst, nausea, vomiting, colic, nor other abdominal pain; that it does not impair, but rather stimulates, strengthens, and regulates the appetite, confining the bowels, rendering the stools black, and depriving them of their fetor, and further, that it produces no general symptoms whatever.[5] Finally, he affirms that on examining the bodies of persons who continued to take the subnitrate of bismuth up to the period of their death, this substance was found in the stomach unchanged in color or otherwise. In the duodenum it is apt to be retained by the valvulæ conniventes, and it gives a bluish color to this part and to the cæcum. In the large intestine it combines with the sulphur of the excretions, turns black, and tinges the mucous membrane with the same color. So far from occasioning ulcers, says M. Monneret, if they already exist in the bowels, the subnitrate protects them from the acrid contents of the intestine, and thus promotes their cicatrization.[6] According to this author, also, the powder traverses the epithelial coat of the alimentary canal, and may be found after death filling the canals of Lieberkuhn, but unchanged in its character, except by the action of the intestinal gases. Headland also maintains that its action is simply mechanical.

This evidence would seem conclusive of the innocuousness of the medicine, but we may append to it that of Trousseau. This eminent therapeutist declared that in all his extensive use of it, he never knew it to influence the circulatory, nervous, or secretory functions, or to occasion any symptoms which afforded the least ground for

[1] Toxicologie, 5ème éd., ii. 10.
[2] Wibmer, Wirkung, etc., i. 423.
[3] Action of Medicines, p. 75.
[4] Bull. de Thérap., xlvii. 213.
[5] Ibid., xxxviii. 436.
[6] Ibid., xlvii. 118.

apprehension. What, then, are we to think of such statements as the following? Kerner mentions the case of a robust, but intemperate man, who, after taking two drachms of subnitrate of bismuth (*Magisterium bismuthi*) by mistake, to relieve heart-burn, died with all the symptoms of corrosive poisoning, including inflammation of the fauces and œsophagus, fever, diarrhœa, colic, suppression of the urine, muscular tremors, and paralysis. On examination of his body, excessive inflammation of the fauces and of the whole intestinal canal, with general gangrene of the former, and gangrenous spots in some portions of the latter, was discovered. The same writer describes among the effects produced by a dose of forty grains of the medicine, oppression or constriction of the epigastrium, faintness, headache, injected conjunctivæ, an anxious expression, a bitter taste in the mouth, thirst, anorexia, and a small, tense pulse. To these phenomena were added violent eructation, colic, sometimes bilious vomiting, and thin evacuations from the bowels.[1] Sobernheim, after narrating Kerner's case, describes another which was fatal in nine days after a like dose, 120 grains, of the medicine had been taken. The symptoms were those of intense gastro-enteritis, and, in addition, swelling of the face, hands, tongue, and abdomen, salivation, spasms of the limbs, dyspnœa, hiccup, and delirium. On examination of the body, the œsophagus, epiglottis, and larynx were found to be gangrenous, the stomach and intestine were highly inflamed, and the vicinity of the pylorus was also gangrenous.[2] Sobernheim attempts to explain the poisonous effects observed in these cases, by supposing that the stomachs of the individuals in question might have contained enough bi-tartrate of potassa to convert the insoluble subnitrate into a soluble and poisonous nitrate of bismuth. In the first case, as quoted by Orfila, it is expressly stated that Kerner's patient took the subnitrate of bismuth in mistake for magnesia, and having mixed it with cream of tartar, swallowed it. This mixture would generate the acid nitrate of bismuth, which has a styptic, caustic, and disagreeable taste, and bears a relation to the subnitrate like that of corrosive sublimate to calomel. To the above extraordinary narratives may be appended the not less extraordinary description given by Lussanna, of chronic poisoning by subnitrate of bismuth. "Its effects," he says, "are colliquative and scorbutic. The patient acquires a leaden aspect; the eyes become sunken, and present a livid subpalpebral circle; the breath is rendered offensive; the gums swell, grow livid, and discharge a sanious blood; hemorrhage is easily excited, and sometimes profuse passive hemorrhages arise."[3] Such effects have not been reported by any other writer than Lussanna, and were never observed by Monneret or by Trousseau, whose use of the medicine was more extensive than that of any other physicians, and who also administered it in the largest doses. The cases of acute poisoning above quoted may be explained, according to Trousseau, by sup-

[1] Wibmer, op. cit., i. 416.
[2] Arzneimittellehre, 6te Aufl., p. 268.
[3] Dublin Quarterly Journal, Feb. 1853, p. 253.

posing the medicine to have contained arsenic; but no preparation of subnitrate of bismuth could contain arsenic enough to account for the symptoms in question. One-sixth of one per cent. is the largest proportion of arsenic that has been found in any specimen of the subnitrate presumed to be pure. The probability remains that when poisonous symptoms were observed they were due to the presence of nitrate of bismuth, and that there is no reason whatever to apprehend such effects from the subnitrate of bismuth prepared according to pharmaceutical rules.

Remedial Employment. *Gastralgia.*—The cases in which Odier originally administered bismuth are described by him as "*spasms of the stomach* brought on by any kind of aliment, and proceeding only from irritability of that organ. This complaint is extremely frequent at Geneva, particularly among servant-maids, who are in the habit of carrying water on their heads, and who make great use of their arms."[1] Marcet describes it in the same terms, and so do Bateman, Clarke, Moore and Bardsley, among those who were the first to publish illustrations of the virtues possessed by the new remedy. This affection, often regarded as a purely nervous disorder of the stomach, and known as gastralgia, is characterized by different painful sensations, and is variously described as a gnawing after food; a violent pain, sometimes so intense as to draw the patient double, and assuaged by firm and strong pressure upon the epigastrium; in other cases, as more steady and constant, and often attended with pulsation in the affected part, or a sense of sinking, followed by nausea and vomiting, and frequently by acid eructations. Oftentimes the desire for food is not impaired, and is only transiently suspended by vomiting. When of long standing, this disease induces debility, loss of flesh, constipation, sometimes with alternations of diarrhœa, and a depression of spirits which is apt to induce a suicidal propensity.

This distressing disorder Odier treated successfully with six grains of bismuth four times a day, though he also tried the medicine in much larger doses. The greater number of practitioners have found the quantity named sufficient, but Monneret, who does not, however, accord to the medicine special virtues in pure or in dyspeptic gastralgia, recommends that not less than two drachms and a half should be given during the first day, and twice as much on the second, after which, he says, the quantity should be increased until the daily dose reaches one, two, or even three ounces. By this method, he insists, cures may be effected which would otherwise be impossible.[2] But the affection to which he especially refers is not neuralgia, but *simple chronic ulcer of the stomach*, in which large doses are essential in order to protect the ulcerated membrane from the injurious contact of the food, and, in this manner, as well as by its more direct and continuous action, to promote the healing of the ulcer.

Subnitrate of bismuth displays a palliative power in cases of pure

[1] Mem. Med. Soc. Lond., vi. 157. [2] Bull. de Thérap., xlvii. 116.

gastralgia; but the more this affection is complicated with other disorders, and especially with such as depend upon an impoverished condition of the blood, the less efficient does the remedy become. Even in cases of simple gastralgia of a severe type and long continuance, its benefits are very transitory; so much so, indeed, as to confirm the belief in its mechanical operation. It becomes necessary, therefore, to administer the remedy frequently, and to associate with it, in the treatment of individual cases, vegetable tonics when the digestion continues feeble after the removal of the pain, alkalies or magnesia when the vomited matters are intensely acid, and iron when evidences of anæmia exist. Constipation, if present, is also to be overcome by means of laxatives, and the best are usually magnesia, or small doses of salines largely diluted. In some cases the action of bismuth is promoted by the administration of a few drops of laudanum or of hydrocyanic acid at the beginning of a meal.

What has been said above of simple ulcer of the stomach is in some degree applicable to open *cancer* of that organ, which, in so far as its interference with digestion may depend upon its ulcerated condition, is favorably modified by large doses of bismuth administered with appropriate food. In this manner the patient is enabled to retain and digest a larger proportion of nutritive matter, and the decay of flesh and strength is retarded.

Diarrhœa.—Subnitrate of bismuth was employed, in 1831, by Dr. Leo, of Warsaw, for the diarrhœa and vomiting of *cholera;* and in the following year, for the same affections, by Trousseau, in Paris. The latter writer informs us that during the epidemics of 1849, and 1854, and especially the latter, the medicine came into general use, not only among physicians, but as a popular remedy, to counteract the premonitory diarrhœa peculiar to the disease. It is hardly less efficient in other forms of diarrhœa, for which antacids and astringents are usually given. It was also prescribed, at an early period, by Guersent, Lombard, and Trousseau, in cases of diarrhœa affecting infants fed artificially, and during dentition, or when they are too suddenly weaned. Two or three grains, mixed with a small quantity of powdered loaf sugar or simple syrup, and administered three or four times a day, are usually sufficient for correcting the disorder. But Monneret, who is even more emphatic regarding the efficacy of the remedy in these affections, and also in the gastro-intestinal softening of new-born infants, affirms that doses like those just mentioned are nugatory, and that from 60 to 300 grains a day should be given to children between the ages of two months and one year—that, in fact, the medicine is as harmless as so much starch.[1] Heller recommends it in similar doses for the like affections, declaring that it can do no harm, and that it speedily cures.[2] Dr. Trask found bismuth associated with calomel by far the most efficient remedy for diarrhœa as it prevailed among the soldiers at Camp Downey, Cal. He generally succeeded in arresting

[1] Op. cit. xlvii. 265. [2] Deutsch. Arch. f. Klin. Med., vi. 107.

the attack within twenty-four hours after the treatment was commenced. The dose of bismuth varied from ten to forty grains, and of calomel from three to ten grains. The dose of the former medicine was in a direct and of the latter in an inverse proportion to the severity of the case.[1]

In various forms of *chronic diarrhœa* bismuth has been employed with marked advantage; in all, indeed, which do not contraindicate the use of astringent medicines. Such, in particular, is the form which depends upon relaxation of the bowels, associated with general want of tone in the system. Trousseau found it a valuable remedy for the diarrhœa which persists in some cases of *typhoid fever* after the decline of the febrile movement. He prescribed from 30 to 120 grains in the course of the day, either alone or in conjunction with lime-water, and sometimes with the addition of a few drops of laudanum. Monneret, however, attributed to it important virtues in modifying and protecting the intestinal ulcers, and enabling the patient to digest nutritious food. Trousseau states that he has frequently employed the medicine in the diarrhœa of phthisis, but unsuccessfully;[2] and Lussanna found it equally unavailing.[3] Other physicians have been more fortunate. Dr. Theophilus Thompson, after repeated trials, declares the result of his experiments to be a conviction that "this is the form to which bismuth is especially applicable, and that, both in efficacy and safety, it surpasses our most approved remedies for the complaint."[4] Dr. T. administered the medicine in doses of five grains, usually combined with three of gum Arabic and two of magnesia, at intervals of four or six hours. Monneret, who, however, prescribed the subnitrate of bismuth in doses of nearly an ounce every day, is still more emphatic respecting its virtues in the present case, whether the diarrhœa attend the forming or the declining stage of phthisis. His testimony is so positive that we quote it literally. "In the last seven years," he remarks, "during which I have administered this medicine in tuberculous diarrhœa, I have seen many persons who appeared to have but a few days to live, cured of their diarrhœa so far as to be able to take food, gain flesh and strength, and quit the hospital under an impression that they were cured."[5] Testimony so positive, and proceeding from such credible witnesses, we may neither contradict nor disregard, and so far as our own experience goes, we should assign to this medicine in large doses the first place among the palliatives of tuberculous diarrhœa.

It is fully supported by the more recent experience of Dr. Trask in simple chronic diarrhœa, which has been already alluded to. When the disease had continued from ten to twelve days it was cured after an average treatment of four days with from sixty to eighty grains of bismuth a day given in one or two doses. When the diarrhœa had lasted from twenty to two hundred and ten days,

[1] Am. Med. Times, vii. 114.
[2] Bull. de Thérap., iv. 267.
[3] Dub. Quart. Journ., Feb. 1853, p. 254.
[4] Med.-Chir. Trans., xxxi. 305.
[5] Bull. de Thérap., xlvii. 217.

the medicine was prescribed in the above named doses, and effected a cure in an average period of five and a half days.

Monneret, and also Lasègue, found this remedy a very efficient one in the treatment of sporadic *dysentery*. It was administered by the mouth, and also by injection, and although it was the only medicine prescribed in many cases, it accomplished a speedy cure.

Externally.—The absorbent, astringent, and protective powers exerted by subnitrate of bismuth have been fully tested by its application in various external or local diseases. Caby treated *gonorrhœa* successfully by means of injections of this substance suspended in water, in the proportion of one part to seven. He used with equal advantage in the treatment of *leucorrhœa*, a dressing of dry charpie sprinkled with bismuth powder, and renewed from day to day. The rapidity of the cure is represented as extraordinary in all cases which had assumed a decidedly chronic type.[1] The efficiency of the application is also said to be equally decided in that form of infantile leucorrhœa which has sometimes been mistaken for gonorrhœa, and which is most apt to occur in feeble and scrofulous children living in poverty and filth. All forms of ulceration of the neck of the uterus, including the cancerous, are favorably modified by the free application of this substance. Other applications, caustics, for instance, may be necessary at first to modify the diseased surfaces; but the good thus accomplised is sustained and perfected by the special protective operation of the subnitrate. The discharges are not only diminished, but their offensive qualities are usually corrected by this application.

No remedy is more efficient than the one under notice in the treatment of *intertrigo*, an affection which often resists, or is aggravated by, ointments and solutions, and by most of the dry powders. According to Gillette,[2] of all the dry applications employed to hasten the cicatrization of *ulcers*, this is the best (provided that the granulations are on a level with the skin), when the secretion of the sore has not sufficient consistence to form a scab, or when its situation exposes it to friction. Such a condition is often presented by scrofulous sores, by the ulcers which follow pemphigus, and those which are of a scrofulous nature. Powdered bismuth has also been found a very serviceable dressing for superficial *burns*, for confluent *smallpox*, *eczema* impetiginoides, and *zona*, for the excoriations of chronic eczema, for *fisures of the anus*, for *bed-sores*, and, in general, for all cases in which there is an acrid or a fetid secretion. Monneret relates the history of two aggravated cases of scrofulous *ozæna*, the one occurring in a woman, and dating almost from her birth, the other in a man, and of five years' duration, both of which were speedily cured by repeated inspirations through the nostrils of finely-powdered bismuth. Nothing else was done than to cleanse the nasal passages by a daily injection of tepid water. Soubrier has also reported favorably of this method.[3] The several affections above enumerated in which subnitrate of bismuth in fine powder

[1] Bull. de Thérap., xlvii. 200; lv. 193, 259. [2] Ibid., xlvii. 418.
[3] Abeille Méd., xv. 166.

has been employed are still more advantageously treated by means of a thin paste composed of bismuth and glycerin. It was first recommended by Dr. T. G. Richardson, of New Orleans, who advised that after the paste is applied the part should be protected by a covering of cotton wadding.[1] Trousseau advised the same compound as an application in fissure of the anus. Here it may be applied on tampons, and as an ointment to various eczematous and other superficial affections of the skin.

Administration.—The dose of subnitrate of bismuth is not restricted within narrow limits. To infants at the breast it may be given in doses of three grains, or more, at intervals of three or four hours, and to adults in doses of ten grains or more, three or four times a day. It is most advantageously administered immediately before eating, mixed with a little milk, cream, soup, mucilage, or other similar liquid. It may also be given in sweet preparations, such as jellies, honey, or molasses; but these are less eligible when the digestive organs are the seat of disease; and as the subnitrate when pure has no taste, the simpler the vehicle of its administration the better.

Dr. Hannon, of Brussels, has proposed the *subcarbonate* as a substitute for the subnitrate of bismuth.

In doses of from seven to ten grains, it is said to act primarily as a sedative upon the circulation, to excite a free discharge of limpid urine, and to diminish the appetite. If, however, it is continued for a few days, these phenomena cease, and opposite effects are manifested. The pulse becomes fuller and firmer, the appetite stronger, the digestion easier, and ultimately the nutrition is improved. The subcarbonate, it is alleged, possesses the advantage over the subnitrate of neutralizing the free acids in the stomach.[2] These presumed advantages are not demonstrated, and the continued existence of the preparation as an officinal preparation is hardly necessary.

Cerii Oxalas.—*Oxalate of Cerium.*

This salt is procured by the direct action of oxalic acid upon the metal cerium. "It is a white powder, insoluble in water, alcohol, and ether, but soluble in sulphuric acid." Its action appears to be local, but whether it directly impresses the nerves, or the tissues surrounding them, is undetermined. Dr. Simpson describes it as a sedative tonic resembling in some degree the salts of silver and bismuth in its operation.

It was introduced into practice by Dr. J. Y. Simpson, who popularized its use in Great Britain.[3] In this country the first illustrations of its virtues were published by Dr. Charles Lee.[4] According to Mr. Curran no other medicine has such a permanent and salutary effect in the *vomiting of pregnancy*.[5] But since he associated with

[1] N. Am. Med.-Chir. Rev., iv. 655.
[2] Bull. de Thérap., lii. 110.
[3] Times and Gaz., Sept. 1859, p. 280.
[4] Am. Journ. of Med. Sci., Oct. 1860, p. 391.
[5] Bost. Med. and S. Journ., Aug. 1869, p. 70, from Dublin Med. Press.

it lupulin, bromide of potassium, bark, and ammonia, this claim in its behalf appears extravagant. Mr. Buck affirms that he has never been disappointed with it; and that he invariably found it a good remedy in irritable stomach, arising from *uterine disturbance* in unmarried females.[1] Mr. Tanner, on the other hand, confesses that it has more frequently caused him disappointment than otherwise.[2] Mr. Lucas claims that it cured dyspeptic vomiting in a case attended with facial neuralgia;[3] but as the neuralgia was first removed by a liniment, it may very well be that the vomiting ceased as a consequence of that cure. The rapidity and completeness with which it arrests the vomiting of pregnancy in many cases, appears surprising after the failure of the medicines usually employed for this purpose; nor is its efficacy in other forms of vomiting less striking. From a comparison of the reports of its operation, as well as from our own experience in its use, we conclude that its efficiency is proportioned to the predominance of the nervous element in those cases of vomiting in which it has proved beneficial.

PLUMBUM.—Lead.

Description.—Lead is usually found combined with *sulphur* in the mineral called *galena*, but it also occurs as an *oxide* (*minium*), and as a *salt*. Its haloid salts are numerous, more so than the sulpho-salts, but less so than the oxysalts. It is, however, from galena, that the lead of commerce is chiefly extracted. This mineral is found in England, Spain, Germany, and other European countries, and also very abundantly west of the Mississippi, from Wisconsin on the north to Arkansas upon the south.

Galena, when roasted, yields the greater part of its sulphur in vapor, forming sulphuric acid, but still retains a portion of it together with oxygen, which forms an oxide of lead. By the further action of heat, after the addition of coal and lime, the remaining oxygen and sulphur are removed. Metallic lead is of bluish-gray color, presents a bright shining surface when freshly cut, has a peculiar taste, and also smell when handled, and a sp. gr. of 11.4. In dry air it undergoes but little change, but, exposed to moist air, it is first oxidized, and then attracts carbonic acid. Pure distilled water exerts no action upon lead, unless atmospheric air be present, in which case a carbonate is formed. Drinking water, which is usually distributed through leaden pipes, contains alkaline and earthy sulphates, which undergo decomposition and are precipitated until the internal surface of the pipe is coated with a sulphate or other insoluble salt of lead. If this surface is alternately exposed to the atmosphere and used as a channel for water, the latter becomes impregnated with lead, and acquires poisonous qualties.

[1] Bost. Med. and S. Journ., Nov. 1869.
[2] Signs and Diseases of Pregnancy. [3] Med. Press and Circular.

The compounds of lead used in medicine are the protoxide, the iodide, the acetates, the carbonate, and the nitrate. We shall succinctly describe the modes of preparing them, and their physical properties.

PLUMBI OXIDUM.—*Oxide of Lead; Litharge.*

This substance is obtained by the action of a current of air upon the surface of lead in a state of fusion. It is in the form of red or yellow, shining scales, without taste or smell, and has the property of forming soaps when heated with fat or oils, in connection with water. It may be used for the preparation of the acetate, subacetate, and nitrate of lead, and enters into the following pharmaceutical preparations:—

EMPLASTRUM PLUMBI.—*Lead Plaster; Litharge Plaster; Diachylon.*

This compound is formed by boiling together oxide of lead, olive oil, and water. The oil and water are supposed to react upon one another, producing oleic and margaric acids, which combine with the oxide of lead, forming the plaster in question, with which also the glycerin unites mechanically.

Lead plaster is usually sold in cylindrical rolls, of a clay color at first, but becoming darker by exposure. It is hard and brittle when cold, but on being warmed, becomes softer and adhesive. With resin it forms *Adhesive Plaster* (EMPLASTRUM RESINÆ), which is usually spread by means of a machine upon linen or cotton cloth. With soap and water it constitutes *Soap Plaster* (EMPLASTRUM SAPONIS).

PLUMBI IODIDUM.—*Iodide of Lead.*

This compound is formed by the double decomposition of nitrate of lead and iodide of potassium dissolved in water, and consists of one equivalent of each of its constituents. It is a heavy gold or orange-yellow powder, without smell or taste, soluble in about 194 parts of boiling and 1235 of cold water, soluble also in alcohol, and decomposed by heat, with extrication of iodine. It should be kept from the access of light.

UNGUENTUM PLUMBI IODIDI.—*Ointment of Iodide of Lead.*

It is prepared by mixing one part of powdered iodide of lead with seven parts of (simple) ointment.

PLUMBI ACETAS.—*Acetate of Lead; Sugar of Lead.*

There are five acetates of lead, but only two of them are employed in medicine, the present one and the subacetate. Acetate of lead is produced by the direct action of dilute acetic acid upon thin plates of lead exposed to the air. It consists of one equivalent of oxide of lead and one of acetic acid with three equivalents of water.

Acetate of lead occurs in acicular prismatic crystals, of a white color, efflorescing slightly in a dry, warm atmosphere, and undergoing decomposition by the carbonic acid of the air. It is soluble in alcohol, and in cold, but much more readily in hot water. In

pure distilled water its solution remains clear, but in ordinary water the acetic is replaced by carbonic acid, which forms a carbonate, and renders the liquid turbid, liberating the acetic acid, and giving to the solution a sour taste and smell. The addition of an excess of acetic acid will redissolve the carbonate. Acetate of lead has a sweetish, astringent taste, and a somewhat sour smell.

Acetate of lead is decomposed by a great variety of substances, including most of the acids and their salts, vegetable astringents, the alkalies and alkaline earths (as in hard water), several mucilages, and albumen; but of the compounds thus formed the only ones which are probably inert are those with sulphuric acid, and other soluble compounds of sulphur.

Liquor Plumbi Subacetatis.—*Solution of Subacetate of Lead.*

This preparation is made by boiling together a solution of acetate of lead with oxide of lead. The acid seizes upon a fresh proportion of the oxide, and two portions of the subacetate result. This salt consists of one equivalent of acetic acid and two of protoxide of lead. It has an alkaline reaction, and a sweetish, astringent taste. It is precipitated from solution by the substances which are incompatible with the neutral acetate, and even more copiously by some of the mucilages, particularly by gum Arabic, which has but little effect on a solution of acetate of lead.

For the convenience of application, a diluted form of this solution is officinal, under the name of *Lead-Water* (Liquor Plumbi Subacetatis Dilutus), and is made with two fluidrachms of the stronger solution to a pint of distilled water. The British Pharmacopœia directs a small proportion of alcohol to be added, in imitation of the *eau végéto minérale* of Goulard, in which alcohol forms about one-sixteenth of the solution.

Ceratrum Plumbi Subacetatis.—*Cerate of Subacetate of Lead; Goulard's Cerate.*

This cerate is prepared by mixing solution of subacetate of lead with white wax and olive oil, previously melted together, and adding to the mixture a small quantity of camphor. It should, as far as possible, be prepared fresh for use, as it speedily becomes rancid.

Emplastrum Saponis.—*Soap Plaster.*

This preparation is made by boiling lead plaster with a semi-liquid solution of soap in water.

Ceratum Saponis.—*Soap Cerate.*

Soap Cerate is prepared by melting together soap plaster, white wax, and olive oil. It is white, and is readily spread upon linen or cotton cloth.

Plumbi Carbonas.—*Carbonate of Lead; Pure White Lead; Ceruse.*

White lead is prepared by several methods. A neutral carbonate of lead may be obtained by the double decomposition of acetate or nitrate of lead and of an alkaline carbonate in solution. By this

process a carbonate of loose texture is produced, too loose for the purposes in the arts for which the compound is designed. The most usual methods are the following. A solution of the subacetate of lead is decomposed by means of a stream of carbonic acid passed through it. Carbonate of lead is precipitated, and a neutral acetate remains in solution. Or thin sheets of lead are exposed during several weeks to the vapor of vinegar raised by the heat generated during the fermentation of tan or stable litter. This fermentation also develops carbonic acid, and reactions like those in the first process ensue; the subacetate parts with one equivalent of its lead, which combines with the carbonic acid to form a carbonate, leaving a neutral acetate, which, in its turn, takes up another equivalent of lead, and returns again to the state of a subacetate.

Carbonate of lead is white, pulverulent, heavy, tasteless, and inodorous; it is decomposed with effervescence by nitric acid, is blackened by sulphuretted hydrogen, and is very slightly soluble in water containing carbonic acid.

Unguentum Plumbi Carbonatis.—*Ointment of Carbonate of Lead.*

This ointment is made by incorporating finely-powdered carbonate of lead with (simple) ointment, in the proportion of one part to seven.

Plumbi Nitras.—*Nitrate of Lead.*

This compound is made by the action of nitric acid on protoxide of lead (litharge), and consists of one equivalent of each ingredient.

It is a white, opaque crystalline substance, which undergoes no change in the air, is soluble in water and alcohol, and has an astringent and sweetish taste.

History.—Lead was known as a metal and employed in the arts long before the Christian era, for it is mentioned in the book of Moses, and Theophrastus describes one of its preparations as a pigment. Hippocrates refers to minium[1] as one of the ingredients of a pessary to arrest hemorrhage during pregnancy, and Nicander, who lived in the second century before Christ, and who wrote a valuable treatise on *alexipharmics*, describes distinctly the phenomena of poisoning by the preparations of lead. Celsus mentions calcined lead among the remedies for hemorrhage, dross of lead among the emollients, and washed lead as an ingredient of a certain malagma for the bones.[2] Pliny describes the manufacture of pipes and plates of lead, and various uses to which the metal is applied. He also states that in medicine it is used to render scars smooth; that plates of it worn upon the loins blunt venereal desires, and prevent nocturnal pollutions; that calcined lead (oxide of lead) is astringent, repressive, and healing, and is used in inflammation of the eyes, to promote the healing of wounds, and to cure excrescences, fissures of the anus, piles and condylomata. Pliny also describes a mode

[1] Μιλτος, Ed. Fœs., i. 267. He also describes (Morb. Mulier., ii. v.) a concave leaden pessary for supporting the womb.

[2] Grieve's Celsus, pp. 207, 214, 223.

of preparing ceruse essentially like that used at the present day, and states that women use this substance to whiten the complexion. He adds, further, that taken internally it is poisonous.[1] The account given by Dioscorides corresponds closely with that of Pliny, and Galen adds nothing but his own confirmation of these statements, and a vain attempt to explain the hidden qualities of the metal,[2] except that water conveyed in leaden pipes sometimes proves deleterious by occasioning dysentery. Aretæus, Aetius, Palladius, Vitruvius, and Paul of Ægina, also describe lead colic and paralysis from lead with more or less minuteness. The symptoms of lead poisoning are still more fully detailed by the Arabian writers, who enumerate among them colic, suppression of urine, constipation, pains, and paralysis affecting the limbs.[3]

The internal use of the salts of lead appears to be of modern origin, and to have been first resorted to by the chemical physicians of the sixteenth century, and especially by Paracelsus and Otto Tachenius.[4] But even in the last century, Boerhaave, after stating that sugar of lead had been recommended as a safe internal remedy for hæmoptysis and other hemorrhages, gonorrhœa, leucorrhœa, etc., adds emphatically that he had never dared to use it, because he had witnessed no striking successes obtained by those who employed it, and he believed it to be a treacherous and dangerous poison.[5] Geoffroy, also, while admitting that it calms effervescences in the blood, and checks the progress of inflammations, and that sugar of lead is by some recommended inwardly for spitting of blood, dysenteries, etc., still concludes by saying that it is much safer to confine it to outward applications.[6] De Haen observes: "Sacchari saturni usus internus laudatur, quia refrigerat et exsiccat, semen extinguit et venerem flaccescentem inducit." Cullen, in 1789, remarks that "hardly any practitioner will now think of employing any preparations of lead as internal medicines."[7] In 1791, Lewis, while admitting the powers of lead to control profuse evacuation, says that "it ought never to be ventured on but in desperate cases, as a last resource."[8] In 1813, Murray, of Edinburgh, expressed a similar opinion.[9] About the same time, on this side of the Atlantic, Barton, in imitation of the practice of Dr. Reynolds, of London, published many years before, employed acetate of lead in hemorrhages, extending the range of cases to which he applied it, and using it also for the cure of dysentery and various profluvia.[10] In Germany it was adopted by Amelung, Kopp, Osann, Jahn, and others,[11] in the treatment of similar affections, as will appear more particularly in the sequel. But in France we find MM. Fournier

[1] Hist. Nat., xxxiv., xlviii. to lv.
[2] Mat. Med., and Comment. of Matthiolus, v. lv., and vi. xxii.
[3] Quoted by Tanquerel des Planches, Maladies de Plomb, 132.
[4] Gmelin, Apparat. Med., Pt. II., i. 414.
[5] Chem. Lect., ii. 456.
[6] A Treatise on the Substances made use of in Physick (1736), p. 239, etc.
[7] Mat. Med., ii. 28.
[8] Ibid., ii. 236.
[9] A System of Mat. Med., i. 285; ii. 347.
[10] Duncan's Med. Com., xii. 190; Barton's Cullen (1812), ii. 20.
[11] Burdach, System der Arzneim. (1818), ii. 232.

and Vaidy using the following singular language as late as 1814. Alluding to the employment of acetate of lead in dysentery by Dr. Ewell, of Washington, they say: "The suggestion, which betrays an utter ignorance of the deleterious qualities of this poison, is so absurd a fancy that we do not think that it even merits discussion."[1] So dogmatic a condemnation could only have been pronounced by writers who fall into the vulgar error of mistaking their own conception of the truth for truth itself.

Action. *On Animals.*—The immediate or irritant properties of lead are illustrated by the effects of the soluble compounds of this metal, the acetates, the nitrate, and the iodide; but the insoluble preparations, the oxides and the carbonate, manifest a poisonous power in so far only as they are converted into soluble salts by the liquids of the economy. The acetate of lead is the preparation which it is of most importance to examine in this connection. When this salt is given to dogs, in the dose of from two to four drachms, it occasions signs of pain, vomiting, loss of flesh, if death is long delayed, or death within a day or two, if vomiting is prevented by a ligature upon the œsophagus. When death takes place speedily, the stomach is found highly injected, and the blood-vessels are gorged with black blood. If the dose has not been large enough to cause death within a few days, paralysis, first of the hinder and then also of the fore limbs, ensues, difficulty of breathing, signs of extreme distress, convulsive respiration, and death by exhaustion. The mucous membrane of the stomach and upper portion of the small intestine is then sometimes found injected, or eroded, and covered with a thick, tenacious mucus; but it seldom or never presents evidences of a true ulceration. The *iodide* of lead produces essentially the same effects as those above described; and *the nitrate* is according to Christison, a powerful irritant and corrosive in the dose of 400 grains.

When the salts of lead are injected into the blood in considerable quantities, death may follow rapidly, with signs of pulmonary congestion, feebleness of the heart, and oftentimes convulsions. The organs mentioned are found overloaded with blood, particularly the lungs and the right side of the heart. It appears probable that these effects and their corresponding symptoms depend upon the coagulation of the blood in the pulmonary vessels, but in some degree also upon a direct sedative influence exerted upon the nervous system. Although, at the present day, it will hardly be supposed that lead can produce the effects with which all are familiar, without having been absorbed into the blood, and with it distributed to all parts of the organism, it may not be uninteresting to have the direct evidence of this fact presented. Tiedemann and Gmelin detected lead in the blood of the portal vein of horses and dogs poisoned by acetate of lead, and Orfila found it in the liver, the spleen, and the urine of animals destroyed in the same manner.

[1] Dict. en 60 vol., x. 384.

Tanquerel, Dévérgie, Guilbourt, Miller, and others, found the metal in the paralyzed muscles of persons who had died of chronic lead-poisoning.[1] Dr. G. Wilson detected it more abundantly in the spleen than in the other organs of animals that perished from the effects of drinking water impregnated with carbonate of lead from a neighboring manufactory, and of eating grass, in the blades and roots of which, and also in beans growing in the adjacent soil, lead was ascertained to be present.[2]

Grisolle states that domestic animals are affected as injuriously as man by the emanations of lead. Cats and dogs frequenting lead manufactories nearly all die in convulsions, being sometimes stricken down suddenly, but sometimes they become blind, and run wildly about, striking against everything in their way. In the midst of their course they are often seized with convulsions, and generally they die in such an attack. These phenomena sometimes manifest themselves after the animal has been for several days dull and dejected: and in certain cases they have been observed after it has drunk water impregnated with carbonate of lead.

On Man. Locally.—In their local operation, the compounds of lead are astringent, and are usually said to be sedative, but they are somewhat unequal in the energy of their action. The nitrate, without being an active irritant, appears to operate as a healthy stimulant when applied to ulcers, which it tends to heal while it lessens the secretion from their surface. By means of its affinity for sulphur, it decomposes sulphuretted hydrogen and thus becomes one of the most efficient of deodorizing agents. This quality has also caused nitrate of lead to be regarded as a disinfectant, but there is no reason to suppose that it affects the specific poisons upon which infectious and contagious diseases depend, further than by depriving them to some extent of the soil most favorable to their development.

Internally, the acetate of lead, in small doses, is sedative, for if continued it lessens the frequency of the pulse; it is also astringent, as its control over excessive secretion from the gastro-intestinal mucous membrane abundantly proves. When an overdose of this salt is taken, as one or two ounces, for example, the following symptoms are usually exhibited. A sweet, styptic, and astringent taste is perceived in the mouth, and a sense of constriction in the fauces; severe gastric and abdominal pains are soon afterwards experienced, and are increased by pressure; there is nausea, very frequent vomiting of a yellowish, greenish, or blackish liquid; the stools are frequent and sometimes bloody; the limbs tremble and are affected with slight spasms, and a sense of constriction; convulsions even may take place. Sometimes there is a giddiness resembling that of intoxication: but the mind may be quite unaffected. The thirst is urgent, the skin hot, the pulse frequent and sometimes strong, but more generally small and tense: the respiration is interrupted and hurried, especially in the latter stages of the attack, and the urine is scanty. Unless aid is given, death may take place in the

[1] Med.-Chir. Trans., vii. 114. [2] Ed. Month. Journ., May, 1852, p. 386.

course of a few hours or days.[1] MM. Rognetta and Flandin deny the probability of this termination, for they assert that the soluble salts of lead may be given to man in considerable doses without occasioning very serious symptoms; but Orfila states that several cases of fatal poisoning by them have occurred, and he treats the assertion just quoted with contempt. Yet it coincides pretty nearly with Dr. Christison's statement, and also with that of Dr. Taylor, who says that "acetate of lead is by no means a very active poison, although it is popularly considered to possess a very virulent action."[2] Several cases might, indeed, be cited in which doses varying from two to eight drachms were taken without injury; but sometimes, without directly destroying life, it induces a protracted derangement of the digestive function which ultimately proves fatal.

Cases of fatal poisoning by the *subacetate* of lead in large doses are recorded in works on Toxicology. Dr. Taylor refers to several examples of this accident. The *carbonate* of lead, on the other hand, does not appear capable of inducing serious symptoms by its immediate influence upon the system. Doses of an ounce, or an ounce and a half, have several times been taken by mistake, or with criminal intentions, without doing any harm.

Far more frequently serious results arise from the slow and gradual introduction of lead into the system. In order to determine the limits beyond which it may not be prudent to go in the administration of the salts of lead, Mr. Laidlaw performed the following experiments upon himself.[3] While in good health, he took sixty grains of acetate of lead in the course of four days. The symptoms developed were these: a metallic taste in the mouth, some tenderness and swelling of the gums, diminished frequency with feebleness of the pulse, and soreness and pain at the epigastrium on taking the last ten grains of the medicine at a single dose. A dose of salts put an end to these symptoms, and no subsequent disturbance occurred. A month afterwards the experiment was repeated. Seventy grains of the acetate were taken in the course of eight days. The metallic savor began to be perceived on the second, and the swelling of the gums on the third day, and the bowels were constipated. On the fourth day, a purge of jalap and rhubarb caused an abatement of the symptoms; but on the sixth day, the medicine having been continued, they returned, accompanied by constriction of the thorax and abdominal pains. By the ninth day, they had increased, and in addition to them there was ptyalism, and a sensation of tightness or numbness of the hands and feet.

A similar illustration is afforded by the case of Dr. Spence, of Virginia, who began by taking a quarter of a grain three times a day, gradually increasing the dose until at the end of three weeks he was taking eight grains twice a day. The symptoms noticed by

[1] Orfila, Toxicologie, 5ème éd., i. 840. [2] On Poisons (Am. ed.), p. 347.
[3] Lond. Med. Repos. and Journ. of Foreign Med. (Philad., 1828), pp. 395 and 527.

Dr. S. were costiveness, spongy gums, "*a livid appearance around the dentes incisores*" (this is the earliest record of that important symptom), diminished flow of saliva, fetid breath, looseness of the teeth without soreness of the mouth, costiveness, and blackened fæces. Neuralgic pains now affected the upper, and afterwards the lower extremities, the appetite failed, and an attack of lead colic supervened, with loss of muscular power in the limbs. The pulse also fell from 80 to 60.[1]

That which happened in these experiments, and even more, is said to have taken place in not a few cases in which acetate of lead was administered medicinally. Tanquerel presents evidence of the truth of this statement in examples drawn from Fernel, Ettmüller, Tulpius, Tralles, Van Swieten, Hoffmann, James, Tronchin, Tissot, Chomel, Fizeau, and Fouquier, to whom might have been added Carrière, Bieking, and others. But lest too much weight should be attached to these names, dating through two centuries of time, it must be added that they who are most familiar with the use of this salt as a medicine, the practitioners of England and America, have scarcely reported a single case in which serious effects have been produced by it. Some colic, and occasionally a troublesome degree of constipation, constitute nearly the sum total of its untoward results.

Lead poisoning is manifested chiefly by a derangement of the nervous system, for even in lead colic the symptoms are evidently due to this more than to any lesion of tissue, and it always results from the gradual introduction of lead into the economy by those who inhale or otherwise imbibe its particles during the manufacture or use of the metal, or who drink water or other liquids impregnated with it. Undoubtedly the stomach and the lungs constitute the ordinary channels of its entrance into the system, but it is probable that all of the mucous membranes, and the denuded cutis, are capable of absorbing it, and that it may, if repeatedly and constantly applied even to the sound skin, be absorbed, and produce its characteristic effects. This is made evident by the liability of type-setters to that peculiar form of paralysis called dropped hands, and also by the not unfrequent cases of lead poisoning which have occurred in consequence of employing cosmetics made with lead. We have seen the characteristic phenomena of lead poisoning arise from the application to the beard of a dye containing this mineral. It should be known that preparations of this metal in contact with the denuded cutis have very frequently occasioned the symptoms of poisoning peculiar to it. Lotions of the acetate or subacetate of lead applied to excoriated or otherwise denuded portions of the skin have produced this effect, and so have lead plasters used to draw the opposite edges of large ulcers together, and lead ointments employed as dressings for open sores. Very small quantities of lead have sometimes developed symptoms of poisoning. Thus, several cases of complete lead poisoning have

[1] Philad. Med. Museum, ii. 250 (1805).

been traced to the use of snuff containing the red oxide of lead, or supposed to have become contaminated by being packed in leaden cases,[1] and also to a very temporary exposure to the emanations of white lead paint.[2] Among the effects of lead are those which are most readily produced by drinking sophisticated wines, or water impregnated with lead, by sleeping in a freshly-painted room, especially if artificial heat is employed to hasten its drying, by living in rooms warmed by painted wood burned in an open fire-place with an imperfect draught,[3] by using or preparing lead paints with spirit of turpentine, by the manufacture of white lead, and by the fumes of the melted metal.

Among workmen in lead the emanations of this metal are apt to produce a peculiar cachexia before the more definite diseases which it gives rise to are developed. Its signs are a loss of flesh, or a flabby state of the muscles, a sickly pallor of the countenance, and, judging from the shrunken state of the veins and discoloration of the skin, anæmia in its most marked degree. Miscarriages among the female operatives, and among the wives of workmen who have suffered from lead-poisoning, are said to be very frequent. The sweetish taste in the mouth, mentioned by Mr. Laidlaw, is perceived, and is accompanied with a sickly fetor of the breath. The gums are sometimes swollen, and salivation occurs, as in his case, and the gums along their attachment to the teeth are often eroded, and present a bluish line. This peculiar symptom appears to have escaped the notice of European physicians until 1834, when it was observed by Dr. Henry Burton, and subsequently described by him as "a narrow leaden-blue line, about one-twentieth part of an inch in width, while the substance of the gum apparently retained its ordinary color and condition."[4] It does not, however, like the red line which precedes mercurial salivation, prove the saturation of the system with the mineral. It is a local effect produced by the action of the sulphur contained in the food, or in the eructations from the stomach, upon the lead mixed with the saliva, and which tends to lodge along the line which has been mentioned. Not unfrequently the discoloration is not limited to the parts indicated by Mr. Burton, but occupies a considerable portion of the gums, and even forms spots upon the lining membrane of the cheeks.

The *colic* produced by lead was, as we have elsewhere shown, well known to the ancients, but one of the first complete descriptions of it, and to this day one of the best, was published by Dr. Warren, of London, in 1768.[5] The name of the disease is derived from one of its conspicuous symptoms, severe pain in the abdomen, which has something of the same character as that of colic from cold or from indigestible food; but the pain differs in these respects, that it is vastly more severe, that it is not subject to such complete remis-

[1] American Journ. of Med. Sci., Oct. 1857, pp. 406 and 542.
[2] Liverpool Med.-Chir. Journ., i. 26.
[3] Arch. Gén., Nov. 1866, p. 603.
[4] Med.-Chir. Trans., xxiii. 66.
[5] Trans. Lond. Coll. Phys., ii. 68.

sions, and above all that it darts in every direction, to the back, loins, uterus, scrotum, and groins, or occupies the thighs and legs, or the muscles of the chest and of the upper limbs. In a word, it has all the characters of a severe neuralgia whose greatest severity is expended upon the digestive organs. Besides the prostration of strength and haggard sunken features which testify to the patient's sufferings, a capital symptom is constipation, which is extremely obstinate, and is accompanied with great retraction of the abdomen, sometimes firm contraction of the sphincters of the bladder and rectum, and retching with frequent vomiting of very acrid, bitter, and somewhat greenish mucus. This symptom is probably due to a spasmodic obstruction of the intestine. Meanwhile there is no fever; the pulse, on the contrary, is infrequent, and the skin cool; but there is sometimes extreme nervous irritability, and even hyperæsthesia of the skin. Many observers have noticed the diminished frequency of the pulse under the influence of the preparations of lead; Tanquerel did not fail to note it: it was a striking symptom in the experiments performed by Mr. Laidlaw; more recently (1852), Barthez observed it when affections of the bowels were treated by saturnine injections; and still more recently (1856), Dr. Corson, of Brooklyn, studied very particularly the feeble action of the heart in persons debilitated by lead poisoning.[1]

The pains which have been described in the preceding paragraph, as affecting the limbs as well as the trunk, sometimes exist independently of the gastro-intestinal derangement described by the term colic. They are said to affect more particularly the workers in minium (red oxide of lead), while colic is more prevalent among the manufacturers of ceruse (the subcarbonate). These musculo-neuralgic pains (for they have many characters of rheumatism as well as neuralgia), are frequently most severe at night, affect the joints and the flexor muscles of the lower extremities, and those of the loins, and in the calf of the leg, especially, are accompanied with severe cramps.

In close connection apparently with the affection just mentioned we must regard *lead-palsy*, a form of disease which was known to the ancients, as has been already stated, but which was first thoroughly investigated by Tanquerel. Usually attacking those who have been long exposed to the emanations of lead, and who have previously suffered from colic, the paralysis is nearly always confined to the extensor muscles, and often to those of a single limb or of a single joint. When the extensor muscles on the forearm are paralyzed, the hand assumes a position which has acquired for this affection the vulgar name of *dropped hand;* a like condition of the muscles of the lower limbs renders progression difficult or impossible; aphonia occasionally results from paralysis of the vocal muscles, and utterance is difficult from feebleness of the muscles of articulation. This loss of power is generally followed, sooner or

[1] N. Y. Journ. of Med., March, 1856, p. 235.

later, by atrophy, and by the permanent bending of the limb by means of the unrestricted action of the flexor muscles.

But the most formidable effects of lead poisoning are those manifested by the central organs of the nervous system. They were first fully described by Grisolle in 1836, and three years afterwards their history was completed by Tanquerel. As in other cerebral affections, sometimes one and sometimes another class of symptoms predominates, delirium, convulsion, or coma giving its peculiar character to the attack. In the delirious variety the intellectual disturbance may be slight, amounting to a mere wandering of the mind, or it may rise to the violence of maniacal delirium. Usually it is continued, but is marked by irregular exacerbations. The convulsive form is the most frequent of all. It has many, indeed most, of the characters of an epileptic paroxysm, is preceded frequently by giddiness and a mental confusion of several hours' duration, and is followed by dulness of perception and intellect, or by raving and violence. This form of attack is very frequently fatal; the patient perishes in a state of coma, or exhausted by the shock to his system. In a third variety, coma, or rather lethargy, is the dominant symptom. The patient is not wholly insensible to external impressions, nor always incapable of expressing himself vaguely, and at times his movements seem to denote that he is in pain. The return of consciousness is gradual, and no recollection of the incidents of the attack remains.

The only lesion which the nervous centres present in fatal cases of lead poisoning with cerebral symptoms, is an apparent hypertrophy of the brain, or at least a state of tension so great that, although there is actually less blood than usual in the cerebral vessels and less effusion in the ventricles of the brain, the surface of this organ has a flattened appearance; and if, before the calvarium is removed, portions of the skull and of the membranes are excised by means of a trephine, the cerebral substance will rise into the opening and even protrude from it.

Tanquerel and Rayer both called attention to the occasional coincidence of saturnine poisoning and albuminuria, and more recently the same fact has been repeatedly noticed, among others, by Ollivier and Lancereaux, so frequently, indeed, that M. Danjoy has endeavored to demonstrate a relationship between albuminuria and those cases of lead cachexia in which cerebral symptoms and amaurosis exist, and which would seem to be the same that is observed between granular degeneration of the kidneys from various other causes and the analogous derangements of the brain and the eye.[1] Cases of sensory paralysis (including analgesia and anæsthesia) have been attributed to lead poisoning even when one half of the entire body was the seat of the affection.[2] But the reality of their supposed causation is open to doubt.

Most of the sources of lead poisoning which have now been indicated are patent, and their effects are scarcely to be avoided unless

[1] Archives Gén., Avr. 1864. [2] Lancet, June, 1865, p. 592.

unusual precautions are observed by those engaged in the manufacture or the use of lead; but there are some among them that act secretly and insidiously, and often undermine health and even destroy life without a suspicion existing of their real character. Lead is a poisonous ingredient in wines. It is now never used to adulterate wine,[1] although it formerly was so for the purpose of correcting the acerbity of many inferior varieties of this liquor. But sometimes wine and other liquors, as beer and cider, become impregnated with lead by running through pipes of this metal, by being kept or served in leaden vessels, or by the leaden pellets (shot) which are used to cleanse bottles, remaining in them and becoming a source of poisonous contamination. Food, particularly when it is acidulous and is cooked or kept in vessels lined or largely soldered with lead, or in earthen vessels glazed with lead, frequently acquires poisonous qualities; and confectionery sometimes is sold which is rendered equally pernicious by the preparations of lead employed to color it. But more than all, water which has dissolved the oxide or carbonate of lead in its contact with reservoirs or pipes of this metal, is a fruitful source of all the forms which have been described of saturine poisoning. It is well known that in many cities the pipes which supply the houses with water are made of lead, and have been so, in fact, for two thousand years. Pliny says that water rises to a level with its source when conveyed in leaden pipes.[2]

It is certain, therefore, that when water thus conveyed produces poisonous effects, it must do so under conditions altogether exceptional. What these are modern science has revealed.

If water is free from saline matter, a hydrated oxide and a bicarbonate of lead are formed and diffused through it, particularly if the free access of air is allowed. Thus, if a piece of perfectly bright lead is placed in distilled water, it rapidly becomes coated with carbonate of lead. Yet this action is prevented by a proportion of saline matter, not exceeding the 15,000th part of the weight of the water. The carbonate, and according to Mr. Taylor, the sulphate of lime in a still higer degree, prevent the action of water upon lead. If the latter salt forms only the five-thousandth part of the weight of the water, no carbonate of lead is produced. The sulphate of lead gradually forms a coating which closely invests the metal, and prevents the production of any oxide or loose crystalline carbonate. Dr. G. B. Wood has suggested, in regard to the saline constituents above referred to, that very probably the sulphate of lime prevents any solution of lead in the water, by the union of its sulphuric acid with any oxide or carbonate of lead that may have been generated, and at the very moment of its generation. He further explains the action of the bicarbonate of lime, by supposing that "one equivalent of its carbonic acid seizes the oxide of lead as fast as formed, and the reproduced carbonate then appropriates the free carbonic

[1] MULDER, the Chemistry of Wine, ed. by H. B. Jones, p. 362.
[2] Hist. Nat., xxxi. 31.

acid in the water, which is thus rendered incapable of acting as a solvent to the carbonate of lead produced."

But in considering the manner in which water conveyed in leaden pipes or preserved in leaden vessels is preserved from contamination, it should not be forgotten that the presence of various mineral substances which exert no chemical action, and, also, of organic particles, exercises a protective power. Mr. Pearsall[1] has proved this to be the case by showing that the quantity of lead varies with substances accidentally and mechanically present in the water, and that the chemical affinities by which the lead is held in solution are so feeble, that the mere presence of foreign bodies may be capable of subverting them.

Poisoning by water contaminated with lead, is probably of more frequent occurrence than is generally supposed, for in some of the most deplorable instances of this accident, the real cause of the mischief remained unsuspected for a long time. This was the case when, in 1848, the exiled royal family of France who resided at Claremont had nearly fallen victims to their own and their medical attendants' want of suspicion, and, perhaps, to a culpable ignorance on the part of the latter concerning the nature of the symptoms they were called upon to witness.[2] The water which supplied the palace was the same which had been used for thirty years, and was so pure that it contained only 5.7 grains of solid matters to the gallon. It was brought a distance of two miles through leaden pipes from a natural pool, and originally to a leaden cistern, in the palace, but this had been replaced by an iron cistern, and the pool, which was partly filled with animal and vegetable detritus, was cleansed. The exposure of the interior of the tube to the air during the progress of these changes, must have allowed some disintegration of the crust that lined it, and the removal of the foreign particles from the water must have permitted it to exert all the action upon the lead which its chemical purity entitled it to, and thus an unusually large quantity of lead was found in the water used for domestic purposes. It is interesting to remark that of thirty-eight persons in the family, only thirteen were affected, and, of these, three only were seriously ill. Thus it is evident that there are peculiarities of constitution which increase the susceptibility to the saturnine poison, independently of the quantity of lead imbibed.

A case very similar to the above occurred on Cape Fear River, in 1853, and is reported by Dr. Anderson.[3] Water of unusual purity was conveyed in a leaden pipe 2000 feet in length, to a reservoir which supplied the workmen of a saw-mill. Those who used most of it were severely attacked, and ten cases in all presented unequivocal symptoms of lead poisoning. The water, on being subjected to the test of iodide of potassium, became speedily tinted with an orange-colored precipitate. These and many similar facts prove, that unless water contains a certain amount of saline con-

[1] Med.-Chir. Trans., xxii. 92. [2] Archives Gén., 4ème sér., xx. 283.
[3] Am. Journ. of Med. Sci., Oct. 1853, p. 374.

stituents capable of forming insoluble compounds with lead, it cannot be safely used as a drink after passing through leaden pipes. If the water, instead of these salts, is contaminated with chlorides (as common salt), it acts readily upon lead, and cannot be taken with impunity.

According to Mialhe, it is by forming a double salt with an alkaline chloride in the stomach, that the preparations of lead become poisonous, for this compound is not precipitated by albumen, and can, therefore, enter freely into the liquids of the economy. Hence the more soluble the salt of lead, the more rapidly does it undergo this conversion, and produce its poisonous effects. The same author suggests, as an explanation of the different degrees to which persons are affected by the same contaminated water, that some consume more salt with their food than others, and thus favor a speedier and more abundant production of the soluble chloride than would otherwise occur.

Treatment of Lead Poisoning.—When an overdose of any preparation of lead is taken, means should be employed to promote its discharge, and then to allay the gastro-intestinal disturbance it may have caused. For the first object, large quantities of mucilaginous drinks containing the sulphate of magnesia or of soda in solution, and a full dose of ipecacuanha, should be administered. When the stomach has been thoroughly emptied, additional quantities of the soluble sulphate should be given, to act as a chemical antidote to the salt of lead in the bowels, and as a purgative. If there should be severe pain at the epigastrium, warm fomentations with laudanum may be applied, or small doses of the sulphate of morphia frequently repeated may be given internally, or used hypodermically. If, as very rarely happens, these measures are insufficient to allay the pain, local depletion may be resorted to. The different methods which have been found successful in the treatment of the chronic poisonous effects of lead, appear to act by eliminating the metal from the economy. Probably a gradual elimination of it is constantly going on by the skin, the bowels, and the kidneys, and it is certain that under the influence of remedies directed to these several organs, the quantity of lead discharged by them is increased. The proof of this in regard to the urinary secretion, will be found in the Article which treats of iodide of potassium. M. Chatin detected lead in the alvine evacuations; and the large quantity excreted by the skin is shown when a person suffering from chronic lead poisoning is immersed in a sulphurous bath. The skin becomes blackened by sulphuret of lead, which can be removed by soap and water, and, in the course of a day or two, if the experiment is repeated, it produces anew the same results.[1]

In the treatment of the saturnine cachexia, the whole of these methods should be employed, whether or not some one or other of the more special forms of lead disorder be present. But it is here, especially, that sulphurous baths are of service. The water used

[1] MIALHE, Chimie Appliquée, p. 354.

should be tepid, and contain five or six ounces of sulphuret of potassium in each bath. The tub itself should be made of wood, and the duration of the bath should be from half an hour to an hour, the skin, meanwhile, being vigorously rubbed with a flesh-brush or with a coarse cloth. Finally, the patient should be well washed with warm soapsuds, in order to remove the lead which discolors the skin. This process ought to be repeated as frequently as twice a week, and as long as the skin affords evidence that lead is still contained in the economy. Conjointly with this measure, the iodide of potassium should be administered in doses of from five to fifteen or twenty grains three times a day, and every other day, at least, a brisk cathartic of sulphate of magnesia should be prescribed.

A special treatment is usually necessary in cases of lead colic, although it has been found that a great many persons suffering from the affection recover if they are removed from the influence of the causes which occasioned the attack, and have the opportunity of resting, and of using an appropriate diet. But where the disease is severe, such negative treatment is not warrantable, and when it is mild it may still be abbreviated and the danger of a relapse prevented by judicious measures. As Grisolle has remarked, "various modes of treatment have been recommended, the uselessness and even the dangers of which have been proved by experience, such as antiphlogistics, tobacco, nux vomica, sulphuretted water, alum, water acidulated with sulphuric acid, and revulsives." The elements of the treatment of lead colic which the most recent observation has sanctioned, are the same that constituted the famous method of La Charité, in 1603, viz., opiates and evacuants. If the state of the tongue and constant sick stomach furnish the indication, an emeto-cathartic (of tartar-emetic one grain, sulphate of magnesia one ounce, water one pint) may be prescribed. It will seldom or but slightly purge, and purgative enemata should then be directed, consisting of an infusion of senna and jalap, while emollient cataplasms are applied to the abdomen, and, at night, a grain or two of opium is given to promote sleep. But the purgative upon which reliance must mainly be placed is croton oil, given in doses of one or two drops, and continued for several days, and even after the complete cessation of the colic. Meanwhile no nourishment should be taken except mucilaginous infusions, whey, or thin broths. Stronger food is not allowable until the function of the bowels is re-established.

It seems to be highly probable that the well-tested efficacy of purgatives, in lead colic, depends upon their power of eliminating the saturine particles contained in the coats of the intestines, and at the same time of powerfully exciting the latter to contraction, for the purgatives which are most efficient are those, also, which are most drastic. This view of the subject appears to be strongly supported by the efficacy of *electricity* in the treatment of lead colic. Mr. Briquet has attempted to show that the pain in this affection is seated not in the intestines, but in the abdominal muscles, and that by means of induced electricity (*faradization*) applied to neigh-

boring points of them through metallic brushes, he was enabled entirely to dissipate the spasmodic pain of the attack.[1] The intense stimulation caused by the electrical current could hardly fail of exciting the intestinal as well as the abdominal muscles, just as cold and heat applied to the surface of the abdomen are familiarly known to relieve pain in the bowels by stimulating them.

In the treatment of paralysis produced by lead, electricity is also a potent remedy, particularly when the affection has become chronic and the muscles are more or less atrophied. Meanwhile, however, every means must be employed to purge the system of the poisonous mineral by sulphurous baths and by iodide of potassium; strengthening dietetic and medicinal measures are also to be prescribed to restore the impoverished blood and the impaired nutrition. As a direct stimulant to the palsied muscles, *strychnia* was generally used before the employment of induced electricity became so general. It may be prescribed internally, in doses varying from a twentieth to a tenth of a grain, gradually increased until spasmodic movements begin to be observed in the paralyzed muscles. It may also be used hypodermically.

The cerebral affections produced by lead-poisoning appear to be very slightly under the control of medicinal agents. If we except opium, which certainly acts with great power in subduing delirious excitement in the maniacal form, there is no other remedy—neither bleeding nor purgatives, nor blisters, nor cold douches to the head, nor quinia, nor anti-spasmodics—which appears to exert any decided control over the course of these formidable affections, which are said to be fatal in about one-half of the cases. Indeed, Tanquerel, after passing in review the different measures, concludes that better than any of them is "the expectant method based upon the use of low diet and diluent drinks."[2]

To prevent the development of poisoning in those who are engaged in manufacturing or using lead and its preparations, various expedients have been devised, but they all resolve themselves into this, viz., to prevent as much as possible the contact of the saturnine particles with the body. Thus the rooms in which the men work should be thoroughly ventilated, flues should be arranged to carry off the vapors produced by heat or by chemical reactions, the grinding of lead should be performed under water, etc. Still more important, but more difficult to obtain, are cleanly habits on the part of the workmen, who should wear over their other clothing a loose garment which they can remove on leaving their work; they should remain in the midst of lead dust and fumes for as short a time as possible; always wash the hands and cleanse the mouth and nostrils with water before eating, and never take their meals in the manufactory; they should use a warm bath and cleanse the skin with soap once a week, keep the bowels free by an occasional dose of olive oil or of castor oil, and on the first appearance of symptoms of impaired health they should resort to medical treatment.

[1] Bull. de Thérap., liv. 54. [2] Op. cit., p. 370.

Use of the Preparations of Lead in Medicine.

Internally. *Hemorrhage.*—The combined sedative and astringent properties possessed by the preparations of lead render them peculiarly applicable in this form of disorder; for while they diminish the power with which the heart forces the blood into the lacerated or flaccid vessels, they increase directly the tendency of the blood to coagulate, and restrain its effusion by constricting the walls of the vessels themselves.

The earliest mention, with which we are acquainted, of lead as an *internal styptic*, was in 1764, when it is said to have been used successfully for the arrest of hæmoptysis.[1] It next was brought into notice by Prof. Barton, of the University of Pennsylvania, who, however, refers to Dr. Reynolds, of London, as setting the example of employing it "as a sedative or astringent in dangerous bleedings from various parts of the body." He exhibited the acetate of lead generally in combination with a small proportion of opium, and sometimes of ipecacuanha. "Seldom," he remarks, "have I been disappointed in my expectations of benefit from the medicine, which, of all the articles of the materia medica, seems to me to possess the greatest command over the movements of the arterial system. In no instance have I perceived any dangerous effects, and rarely any temporary inconvenience, from the employment of lead."[2] The approbation which this distinguished man gave to the use of the medicine induced many of his pupils to employ it. Among them, Dr. G. E. Mitchell reported six cases of uterine hemorrhage cured by its means,[3] and ultimately it became a familiar and habitual remedy in all cases of spontaneous hemorrhage. In 1808, Dr. Ewell, of Washington, D. C., published several cases in which bleeding from the bowels or the uterus, of the most threatening character, was arrested by acetate of lead, given in doses of from three to seven grains every two hours. It was even then remarked by this physician that the advantages of the remedy were more conspicuous when there was excitement than when there was depression of the system.[4] It was the remedy on which Dr. Dewees greatly relied in cases of menorrhagia depending upon plethora, after the use of depletion, and in conjunction with cool air and drinks, and a suitable position of the patient. He prescribed it also for uterine hemorrhage occurring during pregnancy, directing two or three grains of it, with opium, every half hour, or an enema containing twenty or thirty grains of the salt and a fluidrachm of laudanum.[5] Dr. Elliottson urged the administration of acetate of lead, in doses of two or three grains every two or three hours, in different forms of hemorrhage, and did not hesitate to continue it for several days in the same dose, taking care only to keep the bowels open.[6] More recently we find that still larger doses

[1] Med. Museum, Lond., iii. 449.
[2] Barton's Cullen, ii. 21.
[3] Coxe's Med. Museum, 1806, ii. 417.
[4] Med. Repository, xi. 249.
[5] Dis. of Females, 3d ed., pp. 167, 339.
[6] Pract. of Med., 2d ed., p. 152.

have been administered, as by Mr. Sweeting, who was accustomed to prescribe five grain doses at intervals of three or four hours, and who gave, in a case of excessive hemorrhage from the uterus, five grains every hour for twelve consecutive hours, with a favorable result;[1] and by Dr. Lane, of Dublin, who administered ten grains every four hours, for seven days in a case of menorrhagia.[2] This gentleman gave the remedy in five grain doses, at intervals of four hours, in a case of tubercular hæmoptysis which no other remedy would control. In passive bronchial hemorrhage, according to Dr. Stokes, nothing can be more striking than its power to arrest the discharge. Indeed, as compared with other internal styptics which act after absorption into the blood, none is so general in its application, or so certain in its effects. Others have more power in coagulating effused blood, whether upon the external surface of the body, or upon that of the intestinal mucous membrane; but acetate of lead combines in itself the qualities which, as stated in the preceding paragraph, tend to prevent the vessels from pouring out their contents.

Owing to the possession of these peculiar virtues, acetate of lead was at one time used in the treatment of *aneurism*. In the hands of Dupuytren, who employed it in aneurism of the great vessels, it to some extent fulfilled the expectations which were entertained concerning it. Several cases in which the diagnostic marks of aneurism of the thoracic vessels were very clear, were subjected to this treatment. It had the effect of calming the action of the heart, reducing the pulsations and the size of the aneurismal tumor, and diminishing the dyspnœa and bronchial secretions.[3] Bertin also stated that he employed the remedy with some success.[4] Hope said that his experience was in its favor;[5] Walshe explains how, in sacculated aneurism, it may, like other astringents, and sedatives, promote coagulation of the blood.[6] Dr. G. Owen Rees cured a popliteal aneurism as large as a duck's egg by the steady use of this medicine in doses of from three to five grains three times a day.[7] On the other hand, Dr. Bellingham urges that "the administration of acetate of lead is calculated to prove rather detrimental than otherwise; and as aneurism of the aorta is not cured by 'coagulation in the aneurismal sac,' its administration with this object, even if it had the power of causing coagulation, is absurd."[8] The sacculated form of aneurism, we do not hesitate to affirm, is cured, and can only be cured, by coagulation of the blood in the sac; and in so far as acetate of lead and other sedatives and astringents promote its operation, they contribute to the cure. That form, on the other hand, which consists in a more or less symmetrical and local distension of the whole artery, must be cured, if at all, according to a

[1] Am. Journ. of the Med. Sci., Oct. 1841, p. 465.
[2] Braithwaite's Ret., Am. ed., vi. 87.
[3] Archives Gén., 3ème sér., v. 443.
[4] Mal. du Cœur, p. 153.
[5] Diseases of the Heart, Pennock's ed., p. 446.
[6] Diseases of the Chest, 2d ed., p. 772.
[7] Lancet, March, 1865, p. 280.
[8] Diseases of the Heart, p. 619.

different mechanism, and one in which no mere sedative or astringent, certainly, can exert a salutary power. In any given example of aneurism of the great vessels of the trunk, it is perhaps impossible to anticipate the effects of treatment, since the physical conditions vary extremely in different cases. The shape of the aneurismal sac, the size and direction of its communication with the artery, the state of its walls, and finally, the coagulability of the blood may all modify or reverse the normal effects of a given mode of treatment.

Acetate of lead is mentioned by several writers of authority among the sedatives which may be employed in *hypertrophy of the heart.* Brachet has reported several cases in which he found reason to extol its virtues;[1] but, as in every instance it was associated with digitalis in the treatment, the share which the former medicine had in alleviating the symptoms can hardly be appreciated. Valentin, also, claimed for lead the power of curing incipient hypertrophy of the heart; but he adduced no clinical facts to support his opinion.[2] The sedative influence of lead upon the heart is too well determined by the concurrent testimony of competent witnesses, for us to entertain a doubt that it may palliate the violent palpitations which sometimes accompany hypertrophy; but it may well be doubted whether we are justified in continuing to use for an indefinite period a medicine which, sooner or later, must impair the health. As for those cases in which it has seemed to diminish the bulk, as well as the excessive action of the heart, we must not forget that the latter of these always subsides under the influence of repose alone, and that the former, if estimated during violent action, appears to be greater than when the distension of the organ has been reduced.

Bowel Affections.—In this country, it is probable that acetate of lead is used more than anywhere else in the treatment of sporadic *dysentery*, for the remedy here first became popularized among practitioners of medicine. It was not, however, at the time of its introduction, a new remedy for the disease. Ettmüller placed sugar of lead above all other remedies in the treatment of dysentery; and also, in the last century, Moseley described the singular efficacy of glysters containing acetate of lead, in removing inveterate and harassing tenesmus succeeding long continued dysenteries and diarrhœas, where bloody mucus, or sometimes blood, and sometimes purulent matter, is perpetually voided, with intolerable soreness about the anus.[3] In 1807, Hegewisch said that in chronic bowel complaints no other remedy was comparable to lead.[4] Before 1820, Dr. Robert Jackson used a solution of this salt as a local application to the excoriated anus, and prescribed it internally in an acute form of the disease which he denominates "erysipelatous," and says of the remedy: "It is not dangerous; on the contrary, it is of great

[1] Bull. de l'Acad. de Méd., xx. 1204.
[2] Brit. and For. Med.-Chir. Rev., Jan. 1862, p. 235.
[3] On Tropical Diseases, p. 404.
[4] Richter, op. cit., iv. 638.

benefit." He also gave it internally in chronic dysentery.[1] In 1822, Dr. Harlan, of Philadelphia, published seven cases of acute dysentery out of many which he had treated with acetate of lead and opium. In the majority of instances, he found it to check the bloody stools, to allay intestinal irritation, and to relieve in a very prompt manner tormina and tenesmus.[2] In 1826, Dr. T. D. Mitchell, also of Philadelphia, furnished an equally favorable account of its use in dysentery, hemorrhage from the bowels, and cholera infantum.[3] In 1825, Dr. Burke, of Dublin, treated upwards of two hundred and fifty cases of dysentery with this medicine. He thus describes the condition in which it appeared to be most useful: "When the patient is low and weak, either from the continuance of the disease, or from previous bad diet; when the abdominal pain is not constant, nor much increased on pressure; when there is little or no fever; and when the tenesmus and exhausting flow of blood from the intestines form the principal subject of complaint —in these cases I know not any other medicine of equal value."[4] Much more recently, in 1851, Dr. Batchelder, of New York, stated that, although he had a very large experience of the use of this medicine in dysentery, he in no case had known any ill consequences to follow its use.[5] It may be added that in the dysentery of children acetate of lead is recommended by Drs. Condie and J. F. Meigs, and in chronic diarrhœa by Dr. West and Dr. Willshire, of London.

These citations, especially that from Dr. Burke, show the value of the remedy, and the conditions of its safe and useful application to dysenteric affections. As a specific it cannot be recommended; but in sporadic cases of dysentery, when the bowels have been cleansed of fecal accumulations by means of calomel, followed by saline cathartics, or by the latter alone, the utility of the medicine is, we think, incontestable. It should be given in doses of one or two grains, every three or four hours, combined with a quarter of a grain of opium, and its action sustained by enemata of at least half a pint of an astringent vegetable infusion or decoction, or of a solution of subacetate of lead, in the manner presently to be described.

In tropical dysentery, it is probable that this agent is of inferior value, on account of the hepatic complications which are so frequently observed in that form of the disease. Recent writers who have had sufficient experience of this affection in British India, do not esteem very highly its treatment by acetate of lead, except in the hemorrhagic form, where its great value is fully admitted.[6]

The *subacetate* of lead has also been used with marked success in acute and *chronic diarrhœa* and dysentery, by many physicians, as one element of the treatment, and by some as the only medicine.

[1] On Febrile Diseases, etc., 2d ed., ii. 46, 50, 61.
[2] Amer. Med. Recorder, v. 655.
[3] N. Amer. Med. and Surg. Journ., i. 70.
[4] Edinb. Med. and Surg. Journ., xxvi. 56.
[5] N. York Journ. of Med., July, 1851, p. 39.
[6] Morehead, Disease in India, i. 573. Martin, Influence of Tropical Climates, p. 239.

In 1850, M. F. Barthez reported a number of cases in which enemata of a pint of tepid water, containing from one to two drachms of the solution of subacetate of lead, and repeated three or four times a day, or oftener, if the number of stools rendered it necessary, arrested and cured the disease. In some cases, as much as an ounce of the saturnine solution was administered in the course of twenty-four hours. In no instance did the patients experience any effects due to the absorption of lead.[1] The same plan of treatment was also followed by M. Boudin, in between five and six hundred cases of diarrhœa, dysentery, and epidemic cholera, with the most satisfactory results.[2]

Dr. Archer, of Maryland, was probably one of the first who used *acetate* of lead in the treatment of *chronic diarrhœa*, although the astringent properties of the medicine are so evident, that one cannot but feel surprised at its not having sooner come into general use.[3] Dr. Bardsley used it to control the diarrhœa of typhoid fever, Dr. Graves, in cases apparently of the same description, and Dr. Oke, of Southampton, in exhausting diarrhœa following parturition, and in chronic mucous discharges from the bowels.[4] In France, M. Tostain has published many cases of intestinal flux in which a solution of acetate of lead, without opium, was given with marked success.[5] Dupuytren used this preparation in epidemic cholera, but it was Dr. Graves, of Dublin, by whom it was first more generally made known (in 1832) as an efficient means of checking the premonitory diarrhœa of cholera, and the alvine discharges in the fully formed disease. He prescribed about two grains of acetate of lead and one-twelfth of a grain of opium every half hour, until the rice-water discharges from the stomach and bowels began to diminish.[6] The same treatment has been employed by Dr. Parkes and other physicians, but while it appears to stay in some measure the evacuations, it exerts but little influence on the final result of the disease. In the Medical Report to the London Board of Health, in 1855, which contains the statistical results of about 3000 cases of cholera, treated by various methods, acetate of lead seems to have been used in an extremely small proportion of them, and even then combined with opium. It appears, therefore, not to have retained any large degree of the confidence that it once enjoyed.

Acetate of lead, according to Moultrie, was used in the last century to moderate diarrhœa in certain cases of *yellow fever;* and Dr. Irvine, of Charleston, thought it applicable in all stages of the disease, in the first as a sedative, in the second as an astringent to restrain hemorrhage, and in the decline as a tonic. But the general sentiment of those who have tried the medicine in this affection is unfavorable to its usefulness, except in some cases marked by a hemorrhagic disposition, in which it *appeared* to be beneficial.[7]

[1] Actes de la Soc. Méd. des Hôpitaux de Paris, 2ème fasc., p. 59.
[2] Trousseau and Pidoux, Therapeutique, 4ème éd., i. 148.
[3] Méd. Repository, iii. 237.
[4] Braithwaite's Retros. (Am. ed.), viii. 167.
[5] Abeille Méd. xi. 281, 290, 332.
[6] Clinical Med., p. 697.
[7] La Roche, on Yellow Fever, ii. 675.

Evidently, in yellow fever, and also in cholera, the chief influence of lead must be limited to the alimentary canal. The astringency of the medicine may prevent the exudation of blood in the one case, and of serum in the other, but in neither can it probably influence the state of the blood upon which these effusions depend, at least in the former disease.

The astringency of this salt has been found useful in some cases of *tympanitis*, depending probably upon atony of the muscular coat of the intestine. It has been highly recommended by Dr. Bardsley and Dr. Graves in the flatulent distension of the bowels occurring in typhoid fever; and by Mr. Baddeley, in a case of obstinate tympany consequent upon over-active purgation employed for the relief of colic.[1]

At one time acetate of lead was held to be a valuable remedy in *pulmonary consumption.* Richter says that it had long ago been used in this affection, by Seerup in 1700, Hundertmark in 1741, and even in the seventeenth century by M. Ettmüller, while in the present century it was recommended by Hildenbrand, Horn, Amelung, and Kopp, who gave it the title of *solamen phthisicorum.* According to the last named writer, its effects are these: it diminishes the sputa and perspiration, and the frequency of the pulse often as much as ten beats in a minute. In "mucous and purulent consumption of the lungs" it often produces wonderful effects, but in ulceration of these organs it is of no use, and often, indeed, is mischievous.[2] Even Lewis, while speaking timidly of the medicine as a dangerous one, admits that it has the power of "restraining the colliquative sweats attending phthisis and hectic fever."[3] Still later we find Dr. John Latham saying, "Not only in hemorrhages, but in colliquative diarrhœas and hectic perspirations, and more especially in that semi-purulent expectoration which too often terminates in pulmonary ulceration and consumption, have I given the super-acetate of lead in very large quantities, with very considerable advantage."[4] Several years later Fouquier, referring to this subject, said, "In attempting to cure pulmonary consumption with acetate of lead, we have found in this salt a precious remedy for colliquative sweats."[5] Thus, gradually, as pathological anatomy and physical diagnosis rendered the differences apparent between tubercular phthisis and *chronic bronchitis*, the true value of the medicine became established, and showed that its power of diminishing secretion, which could only be palliative in the former, is really curative in the latter affection. Dr. Stokes saw abundant evidence of its astringent action on the capillaries of the lungs,[6] and Dr. Henderson, "that it is a remedy by far the most worthy of reliance in bronchitis attended with profuse secretion."[7] Indeed, the chief morbid element, after increased frequency of the arterial pulse,

[1] Lancet, Jan. 1848, p. 44.
[2] RICHTER, op. cit., iv. 632.
[3] Mat. Med., ii. 236.
[4] Trans. Lond. Coll. Phys. (1815), v. 341.
[5] Bulletins de la Faculté (1819), ix. 441.
[6] Dis. of the Chest, p. 125.
[7] Lond. Med. Gaz., May, 1840, p. 263.

which acetate of lead controls, is secretion, and this it does almost as effectually in diseases which present in a certain degree the inflammatory element, as in those bronchial fluxes which involve no degree of inflammation. In *whooping-cough*, attended with excessive secretion into the bronchia, and still more in the chronic forms of bronchial catarrh to which old persons are subject, and those affected with emphysema and valvular disease of the heart, this medicine is often in the highest degree salutary. The exploded claims of acetate of lead to cure tuberculous phthisis have been revived in favor of the *carbonate* by M. Beau.[1] He conceives that there is an antagonism between lead poisoning and tuberculosis, and hence that the latter may be cured by a mild degree of the former. In favor of this view he cites clinical facts which it may be presumed prudent physicians will be slow to emulate. The treatment of *pneumonia* by acetate of lead, although employed by Burkhardt, Strohl, and Leudet, has nothing to recommend it.

Acetate of lead has been used in the treatment of various *nervous diseases*. Dr. Rush states that by its means he cured several *epileptic* patients under the age of puberty, but that it was unsuccessful in adults.[2] Dr. Spence relates the cure of the disease in his own person by the medicine taken in small and repeated doses until its toxical effects were produced.[3] Dr. Agnew, of Gettysburg, cured a boy seven years old of epilepsy,[4] and Dr. Eberle one in which the disease was of eight years' standing.[5] Dr. Gardiner found it a safe and efficient remedy in many cases of *neuralgia* of the superficial nerves of the face, head, and trunk, and even of the abdominal viscera.[6] Mr. Willey used it with success in some cases of *hysteria* and *chorea*.[7] It is so well known that nervous affections frequently get well under the most opposite methods of treatment, under any cause, in fact, which disturbs the existing condition of the system, that cures of them must sometimes have followed the administration of the acetate of lead; but on examining the sum of experience of this sort possessed by the medical world it will be found to be trivial indeed. Certainly, there are no indications by which the probability of their cure by this substance can be estimated, and it is, therefore, one of the very last which should be chosen in the list of remedies for nervous disorders.

External Use.—The *subacetate of lead* was first introduced into medical practice by Goulard, a surgeon of Montpellier, in 1746, as a secret remedy for the cure of all sorts of exuberant granulations, indurations, and other effects of inflammation, and it was not until five years later that he published the method of preparing it. In his treatise[8] he shows that the external use of lead was anciently common in various diseases, and that even within two centuries it

[1] N. Am. Med.-Chir. Rev., iii. 897. [2] Coxe's Med. Museum, i. 60.
[3] Ibid., ii. 150. [4] Med. Repos., ix. 34.
[5] Therapeutics, p. 280. [6] Lond. Med. and Phys. Journ., lxv. 32.
[7] Med. Repos., ix. 266.
[8] A Treatise on the Effects and Various Preparations of Lead, etc. London, 1784, with the epigraph *Redeunt Saturnia Regna.*—Virg.

had been used by the most eminent surgeons. He then sets forth the utility of lotions, ointments, and plasters, made with it, in contusions, burns, wounds, abscesses, ulcers, cancers, sprains, gout, and rheumatism, various cutaneous affections, ruptures, piles, etc. From the time of Goulard to the present, these preparations have continued to be used whenever an astringent and sedative action is required, to allay pain and inflammation, to lessen discharges, to constringe flaccid tissues, and promote the absorption of morbid products. Whenever they are applied to the denuded cutis, or to a mucous membrane, their use should not be too long continued, lest the symptoms of lead poisoning be developed.

Sheet lead has sometimes been employed as a dressing for ulcers, and *leaden wire* as a ligature for arteries; but these uses of the metal are now almost obsolete.

An ointment made with *carbonate* of lead is occasionally used as an application to burns, scalds, excoriations, cutaneous eruptions, and superficial ulcers, but the dangers of its absorption are thought to be greater than in the case of other saturnine compounds. A mixture of the oxide of lead (litharge) with sweet oil has also been successfully employed in the treatment of *burns*. The acetate and the subacetate, in solution, are applied to a great variety of useful purposes, some of which, as examples of the rest, may be here cited. It should be borne in mind that the last-named preparation is the more powerful of the two, and that it is commonly used in the form of *diluted solution of subacetate of lead*. A solution of 60 grains of the acetate to eight ounces of distilled or soft water, is of the strength ordinarily required.

These solutions, applied on lint, soft cloths, or with bread crumbs, are used to allay inflammatory action after bruises, excoriations, sprains, or fractures; to prevent or moderate the tendency to suppuration in phlegmonous inflammations and enlarged lymphatic glands; and to subdue *cutaneous eruptions*, such as erysipelas, erythema, herpes, eczema, etc. Bretonneau recommended a saturated solution of acetate of lead in wine vinegar to be applied to the inflamed parts in *acne rosacea*, by means of a camel's-hair pencil, and repeated night and morning at first, but afterwards at longer intervals.[1] Irritable *ulcers* and excoriated surfaces are frequently dressed with a solution of the acetate or with the cerate of subacetate of lead. The efficacy of both preparations is increased by the addition of acetate of morphia, in the proportion of one grain or more to the ounce. When, as is sometimes the case, a mucilaginous solution of either acetate of lead is required, flaxseed or the pith of sassafras should be chosen to prepare it, for the mucilages of slippery elm and of quince seeds cause a precipitation of the lead.

In inflammation of *the eye*, with ulceration of the cornea, saturnine solutions should be avoided, as the particles of the salt employed may become permanently impacted in the ulcer and produce

[1] Bull. de Thérap., xxxi. 285.

incurable opacity of the cornea. In acute catarrhal *conjunctivitis*, a solution of one or two grains of acetate of lead in an ounce of rose-water, or of sassafras mucilage made with rose-water, is an excellent and often a sufficient remedy. The more chronic forms of *ophthalmia*, particularly that attended with a granular state of the conjunctiva, in persons of a strumous habit, are said to have been successfully treated by the application of very finely-powdered acetate of lead to the everted lids by means of a moistened camel's-hair pencil. M. Buys, with whom this practice originated, directs that all of the undissolved salt should be removed before returning the lid to its place. He represents the operation to be less painful and much more permanent in its effects than that with the nitrate of silver.[1] Dr. Vetch, of London, represented the undiluted solution of the subacetate as very efficacious in purulent ophthalmia.

A *gargle*, composed of eight or ten grains of acetate of lead dissolved in six ounces of water or mucilage, has been recommended as a means of preventing the development of inflammation of the *tonsils;* also in pseudo-membranous and *aphthous* conditions of the mouth and fauces, and in *mercurial salivation.* Dr. Ewell, of Washington, originally employed this solution for the last-named purpose.[2] It has also been proposed and employed to remedy this troublesome accident by M. Bonnardière and M. Sommé, though Cullerier speaks of it as having been unsuccessful in his hands.[3] When used as a mouth-wash, it gradually renders the teeth slate colored, or entirely black, owing to the formation of a sulphuret of lead. The stain may be removed by a solution or dentifrice containing tannin, applied with a firm brush. Dr. H. T. Reynolds recommends acetate of lead as a means of relieving *tooth-ache* from an exposed nerve-pulp. A grain or two finely powdered should be introduced into the cavity and allowed to remain there for about a minute.

A very common use of these salts is in astringent *injections*, for vaginal *leucorrhœa*, and they are often very efficient in curing this affection. Yet they are less frequently successful than alum. In *gonorrhœa*, or rather in *gleet*, they are of less value than the salts of zinc.

A solution of the *nitrate of lead* (gr. x to ℥j) has sometimes been used as a discutient in the same manner as the acetates, but it is more useful as a deodorizing agent, to correct the fetor arising from *gangrenous sores* and *offensive discharges* from the nostrils, ears, vagina, etc.

The solution of nitrate of lead is an efficient remedy for non-constitutional *ozæna.* The nostril may be washed thoroughly with warm water by means of a syringe holding at least two fluidounces; after which, another syringeful of water, containing five or six drops of the solution, may be injected. This operation ought at

[1] Annuaire de Thérap., 1850, p. 232.
[2] Med. Repos., xi. 252.
[3] Arch. Gén. (1823), i. 483.

the first to be repeated daily or every other day. A still better mode of making the application is by Thudicum's nasal douche.

Iodide of lead is thought to possess discutient powers in a higher degree than the other preparations of this metal. The ointment of iodide of lead, which is officinal, appears in many cases to exert discutient powers. In two instances of hard and painful *tumor of the mamma*, with retraction of the nipple, the enlargement and pain subsided under the influence of this application. In cases of enlarged *cervical* and *inguinal glands*, we have seen it cause a great diminution of the swelling. As an application in the advanced stages of *tinea capitis*, it has been recommended by Dr. Neligan. O'Shaughnessy, Velpeau, and Martin have given it *internally*, and the last-named gentleman states that he cured two cases of *enlarged spleen*, one of them presenting the largest spleen he ever saw, by this method of employing the remedy.[1]

The *cerate* of the subacetate of lead is used in the same cases to which the solution is applicable, but is most generally confined to those in which it is desirable to protect an irritated part against external impressions, and at the same time to promote its healing. It is an excellent dressing for *blistered surfaces* that are indisposed to heal.

Diachylon, or lead plaster, when spread upon cloth, is employed for the purpose of protecting inflamed parts from pressure and from the air, promoting the absorption of effusions into the joints, and also by surgeons for drawing together the edges of wounds, ulcers, etc., and giving support to parts. For surgical purposes, it is rendered more efficient by the addition of resin, and then constitutes *adhesive plaster*. An ingenious application of the latter was first suggested by Dr. Swift, of Easton, Pa.[2] It was more or less fully carried out at the Pennsylvania Hospital, in this city, in 1844 and subsequently by Dr. Ellerslie Wallace; and by others, particularly by Dr. Josiah Crosby, of New Hampshire,[3] and by Dr. David Gilbert, who used it as a means of making both extension and counter-extension in fractures of the thigh.[4] The same method has been successfully employed for this fracture, and also for that of the patella, by Dr. Gaston, of Columbia, S. C.,[5] and by other surgeons.

Soap plaster and *soap cerate* are used, like lead plaster, to make a mild dressing and support for inflamed parts, to discuss the swelling of strumous glands, of chronic inflammation of the joints, etc. etc.

ZINCI ACETAS.—Acetate of Zinc.

Description.—Acetate of zinc is obtained by the direct action of diluted acetic acid upon oxide of zinc. It is a crystalline salt,

[1] Influence of Tropical Climates, p. 289.
[2] Gross, Anat., etc., of the Bones and Joints, 1830.
[3] Am. Journ. of Med. Sci., Jan. 1854, p. 76.
[4] Am. Journ. of Med. Sci., Jan. 1851, p. 70; and Jan. 1858, p. 105. Compare Am. Journ. of Med. Sci., Jan. 1860, p. 435, and Ibid., April, 1869, p. 345.
[5] Charleston Med. Journ., xiv. 610.

usually occurring in white, transparent, rhomboidal plates, which effloresce in a dry air. It has no odor, but an astringent, metallic taste. It is readily soluble in water.

Action and Uses.—The local action of acetate of zinc is that of an astringent and irritant. When taken internally in large doses, it occasions vomiting, and might probably be used for this purpose in the same cases to which sulphate of zinc is applicable.

Acetate of zinc is seldom or never used as an internal medicine. Topically it is applied in all cases of excessive or altered secretion of mucous membranes requiring the use of an astringent; in *ophthalmia*, *leucorrhœa*, and *gonorrhœa*, however, more than in all other analogous complaints. In the former of these affections a solution of one or two grains of the salt in an ounce of mucilage of sassafras made with rose-water, or in the latter solvent only, forms an excellent collyrium. In gonorrhœa, after the acute stage, injections of a solution of acetate of zinc, of the strength just indicated, is one of the best that can be used.

ZINCI CARBONAS PRÆCIPITATA.—
Precipitated Carbonate of Zinc.

Description.—This is an artificial preparation intended as a substitute for the native carbonate, or calamine. It is prepared by mixing together hot solutions of sulphate of zinc and carbonate of soda, by the mutual decomposition of which the officinal carbonate of zinc, in reality a subcarbonate, is obtained. It is a fine, white, loose powder, feeling soft when rubbed between the fingers, and without smell or taste. It is readily soluble in acids.

Action and Uses.—Carbonate of zinc is not given internally, and its topical application is confined to those excoriated or inflamed surfaces which it is desirable to protect from the contact of the air, and moderately to constringe. Hence, in powder, it is very useful in healing blisters which resist milder applications, to prevent the friction of parts which occasions *intertrigo*, and to cure this abrasion when it is produced. In the form of a cerate (Ceratum Zinci Carbonatis) it may be used for the same purposes, and applied to the inflamed edges of the eyelids in *psorophthalmia*, to cure or prevent the *excoriation* of the upper lip by acrid mucus from the nostrils, to heal chaps of these parts and of the hands, and slight local irritations about the nipples, the anus, or the genital organs.

Zinci Sulphas, vid. *Emetics*.

VEGETABLE ASTRINGENTS.

ACIDUM TANNICUM.—Tannic Acid.

Description.—The name of tannin, or tannic acid, is applied to vegetable products which differ among themselves in many respects, but agree in producing a green or a blue-black precipitate with the per-salts of iron, and in forming an insoluble precipitate with gelatinous solutions. Tannin is a constituent of many perennial plants, and is found principally, but not exclusively, in their bark and roots, and usually in intimate combination with coloring matter. As already stated, it differs in some secondary qualities, according to the source from which it is obtained; thus, the tannin of galls is not identical with that of catechu, kino, or cinchona, the first differing from all the rest in being convertible into gallic acid on the exposure of its watery solution to the air. The proportion, also, of tannic acid contained in different astringent vegetables is different. The following is a list of the principal medicinal substances of this class, and the proportion of tannin in each:—

Kino	70 per cent.	Uvæ ursi . . .	36 per cent.
Oak galls (Guibourt) .	65 " "	Pomegranate bark .	19 " "
Catechu (Davy) . .	51 " "	Tormentil . . .	18 " "
Krameria. . . .	43 " "	Oak bark . . .	16 " "

Officinal tannic acid is prepared by acting with ether upon powdered galls, and evaporating the product. It is a whitish or yellowish-white substance, without smell or bitterness, but of an intensely styptic taste. It is soluble in water, and less so in alcohol and ether; its solution reddens litmus paper, and it combines with alkalies to form salts. It precipitates starch, albumen, and gelatin, the soluble salts of iron, lead, and copper, nitrate of silver, the vegetable alkalies, tartar emetic, carbonate of ammonia, etc. Gallo-tannic acid gives a bluish-black precipitate with sesquisalts of iron, but the tannic acid of kino, catechu, rhatany, and some other astringents, furnishes a greenish-black or grayish-black color with the same salts.

Action. *On Animals.*—Mitscherlich introduced half an ounce of tannic acid, dissolved in an ounce and a half of water, into the stomach of a rabbit of medium size. The animal displayed signs of great exhaustion, breathed laboriously and hurriedly, the heart's pulsations were very feeble, and the extremities were paralyzed. Death took place in twenty hours. On dissection, the gastric mucous membrane was gray and lustreless, and in some places softened; the urine gave a greenish-blue precipitate with the chloride of iron, proving the presence in it of tannic acid. From this and other experiments Mitscherlich concluded that tannic acid enters into chemical combination with the epithelium and vascular

layer of the gastric mucous membrane, or rather with the albumen and gelatin which they contain; for if the acid be added to either of these substances, or to milk, it coagulates them, and as regards the former, if the union is complete, they are no longer competent to play any part in the living organism. But this effect only arises when a great excess of the acid is present.[1] It may be stated that no such lesions have been found after death in the bodies of patients who had taken large quantities of the medicine for the cure of disease.

On Man.—The astringent action of tannic acid upon the mouth and fauces has already been referred to. The rapidity of this action appears to be greater than can be explained by supposing it to be chemico-mechanical merely, as Cavarra would have it.[2] But, however produced, it is remarkably persistent, and is due, in part at least, to the coagulation of the mucus already secreted, and to the constriction of the orifices of the follicles which naturally preserve the moisture of the buccal mucous membrane.

When taken internally, in doses of one, two, or more grains daily, it appears to increase the appetite and produce constipation. Mitscherlich states that this condition is not usually persistent, for he has frequently administered from ten to twenty grains three times a day, and that the constipation produced by it has usually ceased spontaneously in the course of two or three days. The late Dr. Tully[3] arrived at similar conclusions. "I commenced," he informs us, "taking ten grains of the pure article, repeating them four times in the twenty-four hours, and continuing about a week, with no more constipating effect than if I had taken so much maize meal. Subsequently a similar trial of this agent was made by several of my professional pupils, and with no more effect as respects the intestinal discharges, than upon myself. This article nauseated a little, however, and impaired the appetite considerably. . . . I have often administered tannic acid in doses of a heaped teaspoonful, at short intervals, till it began to disturb the stomach, in cases of hemorrhage from the lungs, for example, and without any sequelar constipation." No special derangement of the human stomach appears to be caused by it in any dose, when proper precautions are observed, for Dr. Burns, of Glasgow, mentions, in his work on midwifery, that it has been recommended in chlorosis in doses of one hundred grains daily! (*Alison.*)

Upon the stomach its action, at least directly, must be to diminish more or less the secretions of the mucous membrane, if it is taken in large doses. But, practically, in moderate doses it is found to increase the appetite, although the manner of its doing so is uncertain. Clarus maintains that its action on the stomach containing no food is to precipitate the pepsin and interfere with the digestive process; and he alleges in support of this opinion that tea and coffee, which both contain tannin, impair instead of strengthening the

[1] Lehrbuch, i. 241.
[2] Bull. de l'Acad., i. 285.
[3] Mat. Med., etc., p. 1112.

digestion.[1] The theory is probably as untenable as the statement upon which it is based is erroneous; for all mankind who use the beverages referred to, attest that they render the process of digestion easier.

According to Clarus, tannic acid coagulates the mucus of the intestinal canal, and the greater portion of it is evacuated with the fæces united with albumen, or else unchanged, or converted into gallic acid. He is also of opinion that most of the effects which have been held to prove the absorption of tannic acid are really secondary, and depend upon an improved nutrition consequent upon the improved condition of the intestinal mucous membrane. In this way, particularly, he explains the influence of the medicine upon certain morbid discharges which it modifies or controls. Yet he cannot refuse to admit a more direct and immediate action resulting from the absorption of tannic acid; for hemorrhages and various morbid secretions are sometimes controlled with great promptness by the medicine.

But as tannic acid coagulates albumen, it is difficult to understand how it can enter the circulation or retain its properties in the midst of an albuminous fluid like the blood. Besides which we know that it is excreted with the urine, not in its original condition, but converted into gallic acid. Clarus has supposed that the precipitate formed with albumen by a saline solution of tannin, may be rendered absorbable by fat; for he found that on agitating such a solution with an animal oil, a complete emulsion was formed, so complete, indeed, that hardly any separation of its parts took place in the course of half an hour. This fact he made practical use of in the administration of cod-liver oil.

Without some such medium of transport, it is difficult to conceive the possibility of tannic acid entering the blood. Indeed, Buchner, wholly denying that it can do so, attributes all its efficacy in cases of hemorrhage, to the gallic acid into which, he says, it is converted. But here the difficulty occurs, that gallic acid itself is but slightly astringent. How, then, does it, when given internally, or produced from tannic acid in the stomach, exert a styptic power? To do so, as it unquestionably does, it must, in its passage through the blood, acquire qualities that it did not originally possess. Mr. Headland supposes that in this liquid it is transformed into tannic acid by the addition of the elements of grape sugar, which is continually forming during the blood processes connected with respiration.[2] According to this view, the gallic acid excreted with the urine is derived partly from that which is originally absorbed from the stomach, and partly from the reconversion of the newly-formed tannic acid into gallic acid and sugar. It will be observed that the hypotheses of Clarus and Headland do not mutually exclude each other. Either of them is possible, but the former requires the co-operation of fatty matter in the stomach, where it is not always present.

[1] Arzneimittelehre, p. 273. [2] On the Action of Medicines, p. 344.

Uses.—*In impaired digestion* accompanying chronic diseases, Dr. S. C. Alison found tannic acid very efficacious. Symptoms of *dyspepsia* disappeared under its use, the appetite increased, flatulence and the sense of distension were abated at the same time, and in some cases of constipation depending upon debility, the bowels actually became more free.[1] In this indirect manner the medicine may become a tonic, improving the color, strength, and secretions, and, according to Dr. A., in cases of *rickets*, contributing materially to render the bones solid. He also found it useful in cases of *nervous debility*, languor and excitability, when combined with camphor, hops, or hyoscyamus. Clarus considers it a peculiarly useful medicine for small children affected with acidity of the primæ viæ, aphthæ of the mouth, vomiting, *diarrhœa*, and progressive emaciation. In *chronic diarrhœa* Alison gave it in a solid form with more success than any other remedy, especially when the disease appeared to be maintained by a relaxed condition of the mucous membrane. The chronic diarrhœa of drunkards is of this description. In fact, in all cases of habitual and wasting discharges from the bowels unconnected with active inflammation, no remedy is more effectual. In *lientery*, *chronic dysentery*, *cholera-infantum*, *cholera morbus*, the decline of *Asiatic cholera*, the diarrhœa of intestinal tuberculosis, of protracted typhoid fever, etc., it will be found more useful than any other medicine of its class, even more so, perhaps, than the acetate of lead. During the late civil war we found, during an extensive and prolonged hospital practice, no remedy for chronic diarrhœa and dysentery at all comparable to tannic acid associated with opium and a strictly regulated milk diet.

The influence of tannin upon the secretion from the *bronchia* and from tuberculous cavities in the *lungs*, is often distinctly marked, so much so, indeed, that in many cases of chronic bronchitis with a profuse discharge of pus and mucus, no better remedy can be employed with a direct reference to this symptom. Even when *cavities* in the lungs exist, their progress appears to be stayed in some instances by the influence of the medicine in limiting the disintegration of their walls, and, at the same time, the patient being less harassed by cough, enjoys more repose, and is enabled to gain strength and flesh. When the sputa are habitually mixed with blood, it speedily disappears under the influence of tannic acid. These statements have been, in the main, confirmed by the sagacious and skilful experience of Dr. Woillez,[2] who states, however, that he found tannic acid more efficient in recent cases of excessive bronchial secretion than when the habit had become confirmed. Thus it appeared to exert no beneficial influence when this condition attended dilatation of the bronchia, while the opposite was the case when it depended upon congestion from cardiac obstruction, or from the influence of low fevers. In *phthisis* this medicine appeared sometimes to remove the crepitating rhonchi so generally observed around crude tubercles at the apex of the lung during the

[1] Lond. Journ. of Med., ii. 5. [2] Bull. de Thérap., lxiv. 12.

first stage of the disease, while it diminished the dyspnœa, cough, and expectoration. At a late period, again, it manifestly palliated all the symptoms to such a degree as to inspire a belief that a cure had been accomplished, converting moist rhonchi or gurgling into signs of solidification merely, or of a dry cavity. The value of such an influence should not be underrated, for it is in the highest degree probable that the extension of tuberculous deposits is preceded by a congested state of the pulmonary parenchyma, and that by restraining the latter we may prevent the former. Undoubtedly the degree of success which may be expected from this medicine will depend very much upon the slowness of evolution of the tuberculous deposit; the more nearly it resembles the acute form of phthisis the less appropriate will the medicine become.

Tannic acid has been found useful in *whooping-cough*, in which it probably affords relief by limiting the amount of secretion into the bronchial tubes.[1] It is also one of the best means of moderating the excessive *sweats* which attend the last stage of phthisis and other exhausting diseases, and that habitual cold damp upon the skin of persons of a soft and feeble constitution. (*Alison.*) Charvet relates several striking examples of its efficacy.[2]

The various forms of *hemorrhage* are, however, the morbid conditions in which the virtues of the remedy are most conspicuously displayed. It appears to have been first used in cases of this description, for the cure of uterine hemorrhage, by Italian physicians. In 1827, Porta published several cases of menorrhagia in which its efficacy was very marked, and he at the same time stated that it has no effect when uterine hemorrhage depends upon organic causes.[3] Shortly afterwards these accounts were confirmed by Farrario, who found the medicine very useful in passive hemorrhages of the uterus, and by Cavalier, who, like his predecessors, called attention to the innocuousness of tannin even in large doses and when the stomach is somewhat irritable.[4] The appropriate cases for its use are stated by him to be those of passive homorrhage, those also in which the loss of blood has long continued, and induced a state of general debility, and those, finally, in which the congestive tendency has subsided, or has been appropriately treated. This view has been substantially confirmed by Dumare,[5] Alison, and other recent writers, and is applicable to hemorrhages from other organs than the uterus. Dr. Rees, speaking of *hæmaturia* depending upon malignant disease of the kidney, advises tannic acid to be given in alternate doses with the muriated tincture of iron.[6] He prescribes from four to eight grains three times a day. In passive hemorrhage from the *stomach* and *bowels* this remedy is still more efficacious. When the stomach is the seat of the discharge, a large dose should be given at once in solution; but if the intestinal canal is presumed to be its source, the pilular form of the medi-

[1] Frank, Magazin für Arzneim., iii. 901.
[2] Bull. de Thérap., xviii. 287.
[3] Arch. Gén., xiv. 427.
[4] Ibid., xix. 589.
[5] Bull. de Thérap., xxiii. 72.
[6] Lond. Med. Gaz., July, 1851, p. 48.

cine is to be preferred. In the latter case it should be associated with acetate of lead or opium, or both of these agents combined. M. Latour highly extols the efficacy of tannin in *hæmoptysis*. In one case, in which other astringents had failed, it perfectly succeeded; and in three others it was equally successful, but in these the hemorrhage was slight.[1]

Elsewhere the utility of gallic acid in *albuminuria* is illustrated, but experience has proved tannic acid to be equally efficacious in certain cases. This is shown by Garnier and others to have been the case in scarlatinous albuminuria,[2] and in other forms of general dropsy, especially of an acute type, with the same modification of the urine. Thilling reports two cases of dropsy with albuminous urine in which a cure was effected by the administration of tannic acid in divided and frequently repeated doses amounting to eighteen grains a day.[3] It is to be remarked that in these affections the progress of the cure is accompanied by a greatly increased discharge of urine and a progressive return of this secretion to its normal condition. These facts must be added to others which go to show that granular degeneration of the kidney in its incipient stage may be an effect of the condition of the blood rather than a direct cause of the dropsy which accompanies it. M. d'Ormay observes that in a case of tympanites for which he administered tannin, the medicine appeared to produce a copious diuresis. This apparent effect he ascribed to its action in restraining the other secretions, and he claims to have reproduced it in many cases of imperfect secretion of urine arising from general debility.[4]

Among other internal diseases tannic acid has been employed to cure *intermittent fever*, and as an *anthelmintic*, but for these purposes it has no peculiar claim to confidence. Kurzak has proposed tannin as *an antidote to strychnia*. Its efficacy, however, cannot extend beyond its chemical reactions with the poison in the stomach, and the influence of its astringency in retarding absorption. Pyæmia with the formation of metastatic abscesses, appears to have been arrested in its progress by the administration of this medicine.[5]

Externally.—As a local astringent, tannic acid may be used for nearly all the purposes to which any one of its class is applicable. Homolle proposed it as a means of preventing the development of *variolous pustules* upon the face. He used successfully a solution of one part of tannin in four parts of tincture of benzoin.[6] Finely pulverized tannin, used as a snuff, has been recommended in *chronic coryza*, by Trousseau. In the treatment of nasal *polypi*, before these growths have attained a large size, or to prevent their reproduction after evulsion, finely powdered tannin has been found efficient. It is most successfully applied by means of an India-rubber ball, furnished with a tube of greater or less length according to the seat of the growth. One side of the tube presents an oval opening

[1] Am. Journ. of the Med. Sci., xxvi. 201.
[2] Archives Gén., 1859, i. 18.
[3] Abeille Méd, xix. 429.
[4] Bull. de Thérap., lxxiii. 185.
[5] Woillez, Abeille Méd., xix. 342.
[6] Annuaire de Thérap., 1854, p. 214.

through which the powder may be introduced, and which is closed by a sliding cover. Mr. Druitt recommended very highly, for *sore nipples*, a solution of five grains of tannin in an ounce of water, to be applied to the part, and covered with oiled silk.[1] For itching excoriations about the anus and scrotum, which so much annoy old men, he used it with benefit. Van Holsbek, also, found a solution of one part tannin in sixteen of glycerin very efficient in promoting the cure of *fissure of the anus*, when applied by means of a tent introduced into the rectum night and morning.[2] Suppositories of cocoa butter containing two or three grains of tannin are still more effectual. It has also been used with success to prevent *prolapsus ani* and the extrusion of *hæmorrhoids*, and to heal these when in an irritated state, as well as to promote their cure while susceptible of the action of astringents. *Vesical catarrh*, rebellious to all other methods of treatment, was cured by Alquié by daily injections of from fifteen to sixty grains of tannin dissolved in about four fluid-ounces of water.[3]

Mr. Druitt recommends it for the cure of *aphthous ulcers* of the mouth, and for moderating *mercurial salivation;* it is also a very efficient means of reducing *sponginess of the gums*, curing a relaxed condition of the *uvula* and of the *pharyngeal mucous membrane;* and, according to Mr. D., it is most of all to be depended upon as a remedy for *toothache* produced by caries. After scarifying the gum with a fine lancet, a piece of cotton imbued with a solution of a scruple of tannin and five grains of mastich in two drachms of ether is to be placed in the cavity. Tannic acid has been much employed in the treatment of chronic *inflammations* of the surface of the *eyeball* and *eyelids*. Mr. Hamilton, of Liverpool, extols it as superior to all the usual caustic stimulants used for the relief of granular, phyctenular, or pustular ophthalmia, pannus, herpes corneæ, etc. He uses very finely powdered tannin, which is propelled through a tube by pressing an elastic ball; and he claims that this method is more efficacious and less severe than that by metallic salts.[4]

The treatment of *chronic coryza* is always unsatisfactory, unless remedies are applied directly to the affected part. The nasal douche is often available, but a less annoying and painful application consists of a snuff containing tannic acid and white sugar reduced to a very fine powder, which should be forcibly inspired twice a day, or oftener, according to the exigencies of the case. The glycerite of tannin is almost equally advantageous in curing the different forms and degrees of chronic nasal catarrh. It should be applied with a brush after the parts have been cleansed by means of the nasal douche, or otherwise. The same preparation is also serviceable in the relaxed state of the uvula and pharynx, referred to above, both for the purpose of curing it and for preventing

[1] Am. Journ. of the Med. Sci., Jan. 1845, p. 192.
[2] RANKING'S Abstract (Am. ed.), xxv. 148.
[3] Bull. de Thérap., lviii. 216. [4] Practitioner, ii. 347.

that tickling cough to which it gives rise, and which in some cases of phthisis tends to aggravate the pulmonary disease.

As an external application to the skin, when an astringent remedy is required, Mr. Alison thinks it is of especial excellence. He used an ointment of it with remarkable benefit as an application to *psoriasis*. Dr. Ringer[1] speaks highly of the treatment of *eczema* by the glycerite of tannin (Br. Ph.), which contains one part of tannin to four of glycerin, in the early stages of the disease, when the skin is red and swollen, and weeping. By its application two or three times a day the troublesome itching, burning, and tingling are allayed, and hence the irritation of the eruption by scratching is prevented. *Impetigo, and intertrigo* may be treated in the same way. Dr. Woodman[2] asserts that "it is the best external application in the whole materia medica for acute eczema, and for all abrasions and excoriations, both of the skin and mucous membranes." But it can, of course, only be subsidiary to other means. It is of use, also, in preventing local *perspirations*, and particularly fetid discharges from the armpits and feet. Five grains to an ounce of red wine may be used for this purpose.

In chronic mucous discharges tannic acid is often sufficient to arrest the morbid secretion. Injections of it have been used in *gleet*, but they are usually more efficient in the treatment of *leucorrhœa*. They have been successfully employed by Gibert,[3] and Becquerel says that a strong solution of tannin is the best means of treatment. In the former of the two affections a solution of tannin in glycerin, of the strength of ten grains to the ounce, has been found of great service. In leucorrhœa a stronger solution, and even the officinal glycerite, may be advantageously applied on a light tampon of lint, removed every day. Urethral suppositories of cocoa butter and tannin have been successfully used in the treatment of gleet, but they occasion more pain than the glycerite, and are not more efficacious as remedies. *Prolapsus uteri* has been cured in several cases by means of a tampon soaked with a saturated solution of tannin, and renewed daily for a period of four or five weeks. The practice is said to have been first recommended by Dr. B. F. Barker, of New York; and Dr. C. A. Budd, who has employed it, states that many cases of prolapsus, in various degrees, have resulted, without a single exception, in a perfect and complete restoration.[4] Other cases, showing more or less success with this method, have been published by Dr. G. A. Kunkler, of Madison, Ind.,[5] and Dr. Nourse. Mr. Haynes Walton has reported a case of large *vascular tumor* of the orbit cured after injection of a solution of tannic acid. The contents of the tumor were coagulated, and were gradually discharged by ulceration and suppuration, and all trace of it finally disappeared.[6] Other successful cases have more recently been published. A *dentifrice*, according to the following formula, and intended to remove the stains of ferruginous medicines from the teeth, is pro-

[1] Practitioner, i. 28.
[2] St. Andrews's Trans. v. 228.
[3] Abeille Méd., ii. 182.
[4] Med. Exam., March, 1856, p. 190.
[5] N. Am. Med.-Chir. Rev., i. 927.
[6] Times and Gaz., Feb. 1858, p. 149.

posed by Trousseau and Reveil. ℞.—Powdered cinchona, tannin, vegetable charcoal, of each, gr. cl; triturate thoroughly, and add essence of cloves, gtt. v.

Administration.—Internally, tannic acid may be given in the dose of three or more grains, in pilular form, or in solution. The latter form should be preferred in cases of hemorrhage, and the dose may be increased to ten or more grains. Water sweetened with some palatable syrup is the most proper vehicle. Externally it may be applied to a bleeding or suppurating surface in fine powder, or in a saturated solution, or in an ointment. As a simple astringent wash, from three to ten grains may be dissolved in an ounce of water. An ointment may be used (UNGUENTUM ACIDI TANNICI), containing thirty grains to the ounce of lard. The glycerite of tannic acid (GLYCERITUM ACIDI TANNICI) is a convenient form for the local application of the medicine.

STYPTIC COLLOID.—In 1867 Dr. B. W. Richardson called attention to a fluid which is at once styptic, antiseptic, and protective, and which he styled "styptic colloid." It consists of a saturated solution of pure tannin in alcohol, to which ether is then added, and subsequently gun-cotton to saturation. When this liquid is applied to the surface of the body it is rapidly condensed and finally hardened by the evaporation of the solvents, while the tannin coagulates the albumen, if any, upon the part, forming a tough and hard coating. Thus it tends to arrest the discharge of blood, serum, and pus, and at the same time to neutralize any fetor which may be present. In recent wounds, after their edges have been co-aptated by suture or otherwise, the solution is freely applied with a brush, and a thin layer of cotton saturated with the liquid is laid along the line of the injury. Its hardening may be hastened by blowing upon it. This preparation has been used for all the purposes to which collodion has been applied, including the treatment of fractures and ulcers of every description, even open cancers and chancres. Its action may be modified according to its special applications, by the addition to it of carbolic acid, iodine, morphia, corrosive sublimate, etc.[1]

ACIDUM GALLICUM.—GALLIC ACID.

Description.—Gallic acid is rarely found as a natural product, and not at all in those substances which abound most in tannic acid. But it may be obtained by oxidizing the latter, and depriving it of a portion of its carbonic acid. It is prepared by exposing a paste made with powdered nut-gall and water for a month to the action of the air, and after expression, boiling the residue with distilled water, and filtering through animal charcoal. On cooling, the liquor deposits gallic acid in a crystalline form. Prepared in

[1] British Med. Journ., April, 1867; Times and Gaz., Jan. 1868.

this manner, or by the action of sulphuric acid upon galls, gallic acid forms delicate, silky, acicular crystals, colorless and transparent when pure, and slightly acid and styptic to the taste. It is soluble in one hundred parts of cold and three parts of boiling water, is very soluble in alcohol and glycerin and but slightly so in ether, and does not cause precipitates in solutions of albumen or gelatin, or of salts of the organic alkalies. With solutions of the salts of the sesquioxide of iron it gives a dark blue color, and a white precipitate with lime and barytes.

Action and Uses.—As it has been already stated (vid. *Tannic Acid*), gallic acid manifests a very slight astringency when tasted, or when applied to external bleeding or secreting surfaces, but when absorbed into the system it unquestionably controls morbid discharges. Whether it does so by a temporary conversion into tannic acid, or by some unexplained quality of its own, cannot now be determined; but, as its possession of this power is undeniable, we may reasonably infer that in the treatment of hemorrhages, etc., inaccessible to direct applications, we shall accomplish more with a given dose of gallic than of tannic acid.

It is almost exclusively in the various forms of internal hemorrhage that gallic acid has been used. One of the first to employ it was Dr. Simpson, who stated, in 1843, that he had prescribed it in *menorrhagia* with the most successful results. Some of the cases which completely yielded under its use were of long standing and of an aggravated description. He gave it during the inter-menstrual periods, as well as during the discharge, in doses of from ten to twenty grains a day, made into pills. It had no constipating effects upon the bowels.[1] Dr. Stevenson, also, of Edinburgh,[2] and Dr. Neale, of London,[3] found it useful in this affection; and Drs. Ballard and Garrod state that in the treatment of menorrhagia, no astringent which they had employed would bear any comparison to gallic acid, either for the rapidity with which the cure is effected, or for the permanency of the result.[4]

In *hæmoptysis* the medicine has been found very efficient by Drs. Neale, Christison,[5] Homberger,[6] Hart,[7] and others. Dr. Hart used it with success in a very obstinate case of this affection, when other remedies entirely failed.

Hæmaturia is, perhaps, the form of internal hemorrhage in which the action of gallic acid has been most favorable. Christison repeatedly saw it yield to this remedy, and to his testimony, Neale, Stevenson, and Homberger[8] add their own. These reports appear to be confirmed by others which assert its utility in *albuminuria*. It is not to be expected that gallic acid can effect a cure of Bright's disease of the kidney, but it may, even in all forms of that disease,

[1] Month. Journ. of Med. Sci., iii. 661.
[2] Braithwaite's Retros. (Am. ed.), viii. 65.
[3] Times and Gazette, May, 1855, p. 458. [4] Waring's Manual, p. 226.
[5] Dispensatory (Am. ed.), p. 967.
[6] Brit. and For. Med.-Chir. Rev., July, 1850, p. 277.
[7] Boston Journ., Feb. 1856, p. 17. [8] Jahresbericht, etc., 1848, iv. 159.

diminish the amount of albumen secreted, just as the muriated tincture of iron is known to do. In those cases of albuminuria, however, which depend upon temporary causes, as cold, the influence of scarlatina, perhaps conjoined with cold, etc., the urine may be restored to its normal condition, and gallic acid is one means by which this restoration may be accomplished, if the treatment usually adopted during the acute stage of the affection shall have failed to cure. In 1849, Mr. Sampson published several cases of what was probably Bright's disease, and which were improved in a remarkable manner on the administration of gallic acid, the sp. gravity of the urine changing, under its use, from 1.008 or 1.010, to 1.015 or 1.019.[1] These statements were, to a certain extent, confirmed by Mr. Lyell,[2] who adds that in cases where the remedy is likely to do good, its beneficial operation becomes apparent within a few days. In a case of albuminuria with enlarged liver, presumed by its reporter, Dr. H. C. Wood, Jr., to depend upon albuminoid degeneration, the quantity of urine fell, in three weeks, from 2900 c. c. to 1000 c. c., and the albumen finally disappeared, under the use of gallic acid in doses of fifteen grains three times a day. During a portion of the time tannic acid was substituted for gallic acid, with the result of increasing both the quantity of urine and the proportion of its albumen.[3]

Several cases of *purpura hæmorrhagica*, treated with gallic acid by Mr. Grantham, gave incontestable proofs of its efficacy. It was prescribed in five-grain doses every three hours.[4] In *epistaxis* during typhoid fever, in *hæmatemesis*, even when depending upon organic causes, and in *intestinal* hemorrhage, cases might be cited to show the power of the medicine over the exhalation of blood. It must not, however, be expected to prove uniformly successful, for the pathological conditions accompanying hemorrhage are too various to be controlled in all cases by the same means. In the present instance, therefore, we need not be surprised to find that Dr. Gairdner has employed the medicine in several of the diseases mentioned, and with but little effect, and that the experience of Drs. Duncan and Wood, of Edinburgh, doos not differ from his own.[5]

Dr. Bayes has proposed gallic acid as a remedy for *pyrosis*, and refers to five cases in which its efficacy was equally prompt and permanent.[6] As this affection is merely a symptom of different disorders of the stomach, the medicine cannot be expected to be equally successful in all of the cases in which it occurs.

Gallic acid has also been recommended as a remedy for the *night-sweats* of phthisis and other wasting diseases.

Administration.—The dose of gallic acid is from five to twenty grains, which may be repeated three times a day or oftener, accord-

[1] Lancet (Am. ed.), April, 1850, p. 330.
[2] Ibid., p. 353.
[3] Philad. Med. Times, i. 149. [4] Ranking's Abstract (Am. ed.), xviii. 31.
[5] Edin. Med. Journ., April, 1855, p. 353.
[6] Ranking's Abstract (Am. ed.), xix. 83.

ing to the nature of the case. It may be given in substance in the pilular form, or in powder, but its absorption from the stomach is probably most rapid when it is administered in solution. For this purpose the glycerite (GLYCERITUM ACIDI GALLICI) is the most eligible form of the medicine.

CATECHU.—CATECHU.

Description.—Catechu is the extract prepared principally from the wood of *Acacia Catechu*, a native of the jungles and low hills of many parts of India. This is a tree of from 15 to 30 feet high, with thorns on the branches, bipinnate leaves, and numerous white flowers in spikes, followed by a thin, flat seedpod or legume. The inner wood is very hard and heavy and of a dark-red or brownish color, and from this wood, cut into small pieces, medicinal catechu is extracted by boiling.

Catechu comes in masses of a more or less square or roundish shape, and generally of a rusty or dark-brown color externally, but sometimes lighter internally. It is inodorous, but its taste is bitter and astringent, with, at the same time, a certain mawkish sweetness. It is brittle, and has a resinous shining fracture. It is readily soluble in water, especially in hot water, and reddens a solution of litmus. According to Davy's analysis, 100 parts of Bombay catechu contain tannic acid 54.5, peculiar extractive 34, mucilage 6.5, insoluble matter 5. The extractive here mentioned is represented in great part by *catechuic acid*, discovered by Nees von Esenbeck, Jr. The tannic acid of catechu is very soluble in water and alcohol, bnt very slightly so in ether. The solution of catechu yields a precipitate with the salts of aluminium, the acetate of lead, and the salts of the sesquioxide of iron.

History.—The term catechu is derived from the Hindostanee word *catchu*, signifying the sap of a tree; the words *kutt*, *cutch*, *kassu*, are different forms of the same name. It was formerly supposed to be an earthy substance derived from Japan, and was known as *Terra Japonica*. But as early as 1714, Lemery pronounced it an inspissated juice, and not an earth.[1] The first correct account of its origin was furnished by Mr. Kerr, a surgeon of Bengal, in 1773.[2] Its medicinal qualities were first described, in 1601, by Garzia del Huerto, physician to the Viceroy of Goa, who stated it to be an efficient remedy for spongy gums, a drying and astringent medicine, useful also in alvine fluxes, and in removing pains in the eyes. According to Lemery, it is adapted to strengthening the brain, the lungs, and the stomach; is suitable for catarrhs and for hoarseness; to purify foul breath, and cure dysenteries and diarrhœas. In Mr. Kerr's original account of it, he states that the natives of India regard it as a very powerful cooling (sedative?) medicine, and as an anaphrodisiac when too profusely used.

[1] Traité Universel, 2ème ed., p. 198. [2] Med. Obs. and Inquir., v. 148.

Action and Uses.—Catechu appears to be less astringent than tannin, and probably is less gentle than kino in its operation upon the bowels. Its virtues are thus enumerated by Alston: "It is astringent, incrassating, and antiseptic; yea, and antacrid also; called pectoral and stomachic; and commended internally for fluxes, hemorrhages, the lientery, incontinentia urinæ, dysentery, vomitings, diabetes, fluor albus; in coughs, hoarseness, catarrhs, etc., and externally for spongy gums, loose teeth, sore mouths, etc."

For all these purposes, and in all of these affections, catechu continues to be more or less frequently employed. It is very commonly used as an addition to the chalk mixture in *diarrhœa* when this affection is independent of active inflammation of the bowels, as indicated by the absence of fever depending upon the bowel complaint. The compound infusion of catechu is also appropriate in like cases. Catechu may also be used to check *hemorrhage* from the bowels produced by ulceration, or by non-inflammatory exhalation, but not in the acute stages of dysentery. Trousseau and Pidoux state that when administered by them to consumptive patients in the dose of from fifteen to ninety grains a day, it always diminished the cough, expectoration, and fever materially, the diarrhœa less uniformly, and the perspiration but very little.[1] Uterine hemorrhage has been successfully treated by this medicine, but it is not of such efficacy as to be preferred before acetate of lead or gallic acid. Indeed, it is as a local styptic astringent that its merits are most conspicuous, as in the case of the gastro-intestinal discharges already mentioned, but still more so when it is applied directly to the exhaling surface, as in *salivation*, *epistaxis*, and in bleeding from the gums or fauces, and from hæmorrhoidal or vaginal sores. It forms a most valuable ingredient of lozenges to be held in the mouth, in cases of *laryngeal irritation* produced by slight disorders of the mucous folds surrounding the opening of the glottis, or by a relaxed and elongated uvula, or a flaccid state of the pharyngeal mucous membrane generally. Such lozenges are sometimes made with aromatic ingredients, such as cascarilla, amber, orris, mint, etc., for the use of persons troubled with *fetid breath*, and for those who smoke or chew tobacco, and are likewise recommended for public speakers to prevent *hoarseness*. Catechu is also useful when associated with charcoal in the preparation of dentifrices. Gargles containing it are of use in *sorethroat*, without tendency to suppuration.

Mr. Farr has represented the tincture of catechu as superior to any other application for *sore nipples*, when applied twice a day with a camel's-hair pencil.[2] But if it is used during the inflammatory stage, particularly if there is a febrile state of system, it will do more harm than good. Emollient applications must first be employed, such as the following liniment: ℞.—Biborate of soda, gr. x; hot water, f℥j; oil of almonds, f℥vij.—M. It is probable

[1] Thérapeutique, 5ème ed., i. 120.
[2] Lancet, April, 1842, p. 154, and July, p. 523.

that if the tincture or a solution of catechu were applied during the last weeks of pregnancy, it would prevent the nipples from becoming sore. Mr. James Kerr states that an ointment of great repute in India is composed of catechu four ounces, sulphate of copper four drachms, alum nine drachms, white resin four ounces. These substances are reduced to a fine powder, and mixed with olive oil ten ounces, and water sufficient to bring the mass to the proper consistence of an ointment. It is used "in every sore, from a fresh wound to a venereal ulcer."[1]

Administration.—The dose of powdered catechu is from ten grains to thirty, and of the tincture (TINCTURA CATECHU) from half a fluidrachm to three fluidrachms. The compound infusion of catechu (INFUSUM CATECHU COMPOSITUM) is made by adding a pint of boiling water to half a troyounce of catechu and sixty grains of cinnamon, macerating for an hour, and straining. Dose, from one to three fluidounces.

CHIMAPHILA, vid. *Diuretics.*

CREASOTUM, vid. *Stimulants.*

GALLA.—NUTGALL.

Description.—Nutgall is a morbid excrescence upon *Quercus infectoria*, a shrub which abounds in Asia Minor and Central Asia. It is produced upon the tender branches by the puncture of *Cynips gallæ tinctoriæ*. The female of the insect deposits her egg in the wound which she has made, and around it the nutgall is gradually developed, and serves for food to the larva after it is hatched, and until it makes its escape through an aperture which it bores for itself. Nutgalls are of about the size of a filbert, rounded and tuberculated upon the surface, heavy, and so hard that they cannot be broken without the aid of a hammer. When collected before the full development and escape of the insect, they are of a bluish or blackish-green color; but after the insect has escaped, they are of a lighter color, less heavy, and also less astringent. The former are, therefore, the only ones that should be used for medicinal purposes.

According to the analysis of Guibourt, nutgall contains 65 per cent. of tannic acid, and only two per cent. of gallic acid, together with small proportions of bitter extractive matter and gum.

History.—Nutgalls were used for medicinal purposes by the ancients. In the Hippocratic writings it is stated that they were administered internally for uterine hemorrhage, and used locally in prolapsus uteri, in an ointment to cure foul ulcers, with wine as an application to the anus after the excision of hæmorrhoids, and also with myrrh and alum upon enlarged veins.[2] A similar account

[1] Loc. sup. cit.
[2] DIERBACH, Die Arzneimittel des Hippokrates, p. 98.

is given by Dioscorides, Galen, and the Arabian writers, who also describe the mode of production of these bodies.

Action and Uses.—The principal quality of nutgall is astringency, depending upon the tannic acid which it contains, but the bitter extractive matter probably modifies in some degree its astringency by exerting a tonic action. On this account, the infusion of nutgall, its watery extract, and a syrup prepared with the tincture of nutgall, or with an infusion of powdered nutgall in brandy, have been found very efficacious in cases of *chronic diarrhœa* connected with debility and impairment of the system. A syrup of nutgall with iron is recommended by Trousseau and Pidoux, under similar circumstances.

Nutgall has been also proposed as an antidote to poisoning by tartar emetic and the vegetable alkaloids, on the ground of its forming insoluble compounds with these substances. If it is efficacious in such cases, which, however, is not sufficiently proven, it is quite as probably owing to its astringency, which renders the mucous membrane of the stomach and bowels inapt for absorption, as for the chemical reason which has been stated.

As an external application, the infusion of nutgall is often used to give firmness to the *relaxed mucous membrane* of the mouth and fauces, the vagina, and the rectum, but it is a less efficient and a less elegant preparation than a solution of tannic acid. The ointment of nutgall is frequently applied to *hæmorrhoids*, and in other relaxed or irritated conditions of the anus and rectum. Under such circumstances, equal parts of ointment of nutgall (*Unguentum Gallæ*), Goulard's cerate, and stramonium ointment, form a very efficient combination.

An infusion, made with from half an ounce to an ounce of coarsely powdered nutgall in a pint of boiling water, may be given in the dose of a wineglassful three or four times a day. The tincture (TINCTURA GALLÆ) is seldom used as a medicine.

GERANIUM.—GERANIUM.

Description.—Geranium, or cranesbill, is the rhizome of *Geranium maculatum*, an indigenous herbaceous plant, growing throughout the United States, and generally in moist, low situations. The stem is erect, one or two feet in height, with large petiolate, lobed, and serrated leaves, which, like the stem, are of a pale green color. The flowers are large and usually of a purple color. The rhizome is perennial, horizontal, and fleshy, and, when dried, is of a dark-brown color externally, and of a pale flesh-color within. It is inodorous, and has a very astringent taste, without bitterness. It yields its properties to water and to alcohol. They appear to depend upon tannic and gallic acids.

Action and Uses.—Cranesbill is said to have been used by the aborigines as a medicine. Eberle pronounces it the most agreeable astringent that we possess, on account of its not being associated

with bitterness or any other unpleasant taste. On this account, it has been much used as a domestic remedy, and by physicians in the *bowel complaints* of children, and a decoction of it in milk is frequently administered in *cholera infantum*. In *aphthous affections* and ulcerations of the mouth and throat, it may be prescribed as a wash or gargle, and in a relaxed state of the mucous membrane of the same parts. It has also been recommended as very efficacious in restraining internal *hemorrhages*, and is said to be efficient as an injection in *gleet* and *leucorrhœa*.

Administration.—This medicine may be given in substance in the dose of from twenty to forty grains; or in a decoction made by boiling an ounce of the root in a pint and a half of water to a pint, of which the dose is one or two fluidounces. To infants, a decoction made with an ounce of the root in a pint of milk, may be given in teaspoonful doses, repeated according to the susceptibility of the stomach, or the urgency of the case.

Granati Fructûs Cortex.—*Pomegranate Rind.*

Granati Radicis Cortex.—*Bark of Pomegranate Root.*

Vid. *Anthelmintics.*

HÆMATOXYLON.—Logwood.

Description.—This is the heart-wood of *Hæmatoxylon Campechianum*, a native tree of Campeachy, but naturalized in many of the West India Islands. The tree is of medium size, has a contorted trunk, and is covered with a rough bark. The branches are crooked, and beset with sharp thorns. Logwood, so called from its being imported in logs or long billets, is of a dark reddish-brown color, very hard and compact, and susceptible of a high polish. It has rather an agreeable odor, and a sweetish and somewhat astringent taste. In the shops it is found cut into chips or rasped into a coarse powder. It yields its virtues to alcohol and water, and imparts to these liquids a deep purplish-red color, on which account it is extensively used in the arts as a dye.

Action and Uses.—Logwood is, according to Alston, "subastringent, and probably also antiseptic and diuretic." Lemery calls it "astringent and stomachic," and various writers agree that it possesses tonic as well as merely astringent properties. As was long ago noticed by Lewis[1] and by Percival,[2] it darkens the fæces, and sometimes tinges the urine of a purplish or dark color, and gives it an astringent taste. This color has sometimes erroneously been attributed to blood in the urine. It has not a constipating effect in the same degree as the purer astringents, and hence is inferior to them whenever a flux is to be diminished by a direct action upon

[1] Mat. Med., 4th ed., ii. 61. [2] Essays, 4th ed., ii. 386.

the secreting part. In Pereira's *Materia Medica* two cases are referred to in which the arrest of chronic diarrhœa by means of logwood was followed by phlebitis of the femoral vein.[1] It may be presumed that in these cases the intestine was ulcerated, and that the phlebitis which followed the administration of logwood would equally have followed that of any other astringent which suddenly arrested the secretion from the diseased surface.

The general uses of logwood are the same as those of other vegetable astringent medicines, to control *diarrhœas* and other fluxes, to repress *hemorrhages* and excessive *sweats*, and to cleanse foul ulcers. Recently, M. Desmartis has eulogized the antiseptic and healing qualities of this substance in *gangrenous*, fœtid, and ill-conditioned *sores*.[2] It is less efficacious than tannin itself, and other articles belonging to the same class. Its comparative mildness is thought to give it a preference over tannin in the treatment of *infantile diarrhœa*.

Administration.—The decoction and the extract of logwood are officinal. The *decoction* (Decoctum Hæmatoxyli) is prepared by boiling a troyounce of rasped logwood in two pints of water down to a pint, and straining. A little bruised cinnamon may be added with advantage at the end of the boiling. The dose for an adult is two fluidounces, and for a child of two or three years old two or three fluidrachms. Of the *Extract* (Extractum Hæmatoxyli) the dose is from ten to thirty grains given in solution.

KINO.—Kino.

Description and History.—"Kino is the inspissated juice of *Pterocarpus Marsupium* and of other plants." The first account published of this substance was in 1757, by Dr. John Fothergill, who proposed to name it *Gummi rubrum astringens Gambiense*, on account of its having been brought from the river Gambia.[3] A few years ago, Dr. W. F. Daniell, being stationed on the Gambia, availed himself of the opportunity afforded him of investigating the botanical source of African kino, and concluded that it is derived from *Pterocarpus erinaceus*.[4] In India a variety is used which is imported from New Holland,[5] and is known as Botany Bay Kino. It is said to be the inspissated juice of *Eucalyptus resinifera*, while that which is imported into England from Bombay and Tellicherry, and is known as *East Indian Amboyna kino* (*Pereira*), was not ascertained to be the product of any native tree until the investigations of Dr. Royle determined it to be the inspissated juice of *Pterocarpus marsupium*. The same writer has also rendered it probable that the name kino is of Indian origin, for the natives of Hindoostan apply the term *kuenee* or *kīni* to a similar exudation from the bark of *Butea frondosa*. There are two American varieties

[1] 4th ed., vol. ii., pt. ii., p. 347.
[2] Bull. de Thér., lxiii. 139.
[3] Med. Obs. and Inq., 3d ed., i. 358.
[4] Am. Journ. of the Med. Sci., July, 1855, p. 185.
[5] Ainslie, Mat. Ind., i. 185.

of kino, the one known as *West India* or *Jamaica kino*, the product of *Coccoloba uvifera*, and the other called *South American* or *Caracas kino*, whose botanical source has not yet been discovered.

There does not appear to be any essential difference among these different varieties of kino. They all are of a reddish-brown color, thin portions are of a garnet-red by transmitted light, and they are readily broken into shining angular fragments. East India kino comes in such fragments, but the West Indian and South American varieties are in large masses. Kino is inodorous, and has a bitterish, highly astringent, and somewhat sweetish taste, and dissolves imperfectly, but becomes soft and adhesive in the mouth. It is partially soluble, when recent, in hot water—which, however, becomes turbid on cooling—and also in alcohol, and gives to its solutions a blood-red color. According to Vauquelin's analysis, the constituents of East Indian kino are: *tannin* and *peculiar extractive* 75, *red gum* 24, insoluble matter 1. More recent analyses have determined its constituents to be kinoic and tannic acids, pectin, ulmic acid, and inorganic salts with an excess of earthy bases. With the sesquisalts of iron it furnishes a dark-green precipitate.

Action and Uses.—It was early noticed as a peculiarity distinguishing kino from other astringents, that it is possessed of "a gummy nature" (*Lewis*), or, as others expressed it, "an aromatic quality" (*A. Fothergill*), and on this account it was from the beginning much employed in recent *diarrhœa*, after the use of evacuant remedies. Even in France, during the reign of the "physiological doctrine," its utility in these cases was recognized. Bally relates that when there was violent pain and even tenderness on pressure, with fever, twelve or fourteen grains of kino, given three, four, or five days, successively, proved sufficient to effect a cure.[1] Sandras, soon afterwards, insisted upon the same fact. Kino, he remarks, is not an irritant whose local action is to be dreaded, but it is a sufficiently powerful astringent to promptly arrest diarrhœa. Going even further, he says, with reference to chronic diarrhœa, although the patient should present symptoms of chronic irritation of the gastro-intestinal mucous membrane, and his strength forbids a resort to antiphlogistic treatment, even if the stools are composed of a bloody liquid, kino, supported by an appropriate regimen, will often repress these symptoms, and restore the health which appeared to be irretrievably lost. He also found it a peculiarly appropriate remedy in the declining stages of enteritis (?) but not when diarrhœa was dependent upon ulcerations of the intestine, as in tuberculous phthisis.[2]

In gastric disorders accompanied with excessive mucous secretion in the stomach, it has been thought to possess peculiar advantages. Long since it was used by Pemberton as a principal remedy for the affection known as *waterbrash* (*pyrosis*). in its incipient stages. He associated it with a small proportion of opium. "I prefer the kino," he remarks, "to any other astringent, because, unless there is a

[1] Lond. Med. Gaz. (1830), v. 700. [2] Bull. de Thérap. (1834), vii. 189.

diarrhœa, it appears to have no tendency to confine the bowels."[1] In the same affection Dr. Watson recommends a similar medicine, the *pulvis kino cum opio* (*Br. Ph.*).[2] It, however, contains cinnamon, which is an objectionable ingredient under the circumstances. Dr. Chambers also says that kino is certainly of great use in cases where gastric flux is complicated with pyrosis, and he makes the same remark as Pemberton, that in these cases, even when joined to opium, it does not produce constipation; sometimes, indeed, it relieves that symptom by removing the general state of irritability and discomfort, and perhaps, by checking the secretion of mucus. In cases attended with much gastric pain, he associated kino and bismuth.[3] Dr. James Turnbull also mentions kino as one of the best remedies for these affections.[4]

Another disease in which this medicine has been found serviceable, is *diabetes*, and not only the insipid, but also the saccharine form. Pemberton recommended it; Sandras, in a paper already referred to, relates a case of saccharine diabetes which it cured, and Prout mentions it among the astringents which are occasionally of service.[5] Dr. Watson found that in the last stages of *phthisis* the compound powder of kino is an admirable medicine in controlling both the perspiration and the diarrhœa, and in calming the cough.[6] Kino was originally used with advantage in *menorrhagia*, but more efficacious remedies have supplanted it; and in some cases of intestinal and gastric hemorrhage it has been found efficient when given in substance and in large doses.

As a local astringent, kino has been used to contract the granulations of flabby *ulcers*, and to cleanse and constringe those of a foul or scorbutic character. A solution of it in red wine is preferable in such cases. A watery solution may also be used as an injection in *leucorrhœa*, and in *dysentery;* and finely-powdered kino may be applied as a *hæmostatic* to bleeding surfaces. But in all of these cases it is probably inferior to tannin.

Administration.—Kino may be given in substance, in *pill*, or *powder*, and in the dose of from ten to thirty grains. 120 grains of kino dissolved in eight fluidounces of boiling water, and strained when cool, form an *infusion* which may be prescribed in the dose of one or two tablespoonfuls. The infusion prepared in this manner may serve as a convenient vehicle for chalk in the treatment of diarrhœa. When the tincture is used as an ingredient of the chalk mixture, the gummy matter of the kino is apt to coagulate.

KRAMERIA.—Rhatany.

Description.—Krameria is the root of *Krameria triandra*, a native plant of Peru, with a long, dark, procumbent stem, bearing numerous

[1] Dis. of the Abdominal Viscera, 4th ed., p. 111. [2] Lectures, 3d Am. ed., p. 780.
[3] Digestion and its Derangements, p. 343 and p. 364.
[4] Disorders of the Stomach, p. 116.
[5] Stomach and Renal Diseases, 4th ed., p. 51. [6] Op. cit., p. 651.

spreading branches and bright red flowers. The young leaves are pubescent and shining. The roots are long and spreading, and of a blackish-red color. As found in commerce, rhatany consists of cylindrical pieces from one to several feet in length, and varying from an eighth of an inch to an inch in thickness; or of numerous radicles attached to a short, thick root-stock. It is composed of a cortical and a central or woody portion. In the former the virtues of the root chiefly reside, and it has a very astringent and somewhat bitter and sweetish taste. Cold, warm, and boiling water extract its virtues, but alcohol more perfectly. The decoction is much less astringent than the infusion. Of its preparations the cold infusion is the best. According to Gmelin, rhatany contains 38.3 per cent. of tannin, with sweet matter and mucilage, together 15 per cent.; and Peschier has discovered in it a peculiar acid which he calls *krameric*. An infusion of rhatany is precipitated by gelatin, and gives a brownish-gray precipitate with sesquichloride of iron.

History.—Rhatany was discovered in Peru by Ruiz in 1779. Five years afterwards he found that the root was used by the ladies of Huanuco to whiten their teeth and render the gums firm and of a healthy color, and suspecting from this circumstance that it must possess astringent qualities he administered it in cases of hemorrhage from the stomach and womb. Some of the root was carried to Spain, and found efficacious in similar affections, and in 1796 Ruiz published an account of its virtues in the *Memoirs of the Academy of Madrid*. It was not until 1816 that the virtues of rhatany became generally known, when Hurtado, a Spanish refugee in Paris, presented to the *Société d'Emulation* of that city, a paper in which the history of the drug was narrated, and numerous cases observed by Ginesta, Bonafos, and himself were related to demonstrate its virtues as a cure for passive hemorrhages.[1] Pereira states that it was introduced into England in 1808, and that Ruiz's dissertation on it appeared in an English dress in 1813, but no mention of the drug is contained in the second edition of Dr. John Murray's *System of Materia Medica*, published in 1813. In this country it was not noticed in the edition of Chapman's *Therapeutics*, published in 1831.

Action and Uses.—The operation of rhatany in the system does not differ materially from that of kino and catechu, but perhaps it more closely resembles the former than the latter in its effects. Like these medicines, it is somewhat tonic in small doses, in larger ones powerfully astringent, and in the latter case has a tendency to produce gastric uneasiness and oppression.

As it has been stated above, the original application of krameria in medicine was in cases of passive *hemorrhage*; in *uterine* hemorrhage after labor, *menorrhagia*, *hæmaturia*, *hæmoptysis*, *hæmatemesis*, and *epistaxis* it was represented as having proved very efficacious. In these affections its virtues have been since confirmed by Koop, Sachs, Sundelin, and others. Dr. Watson refers to a case of *hæma-*

[1] Journal de Médecine (de Leroux), Nov. 1816, xxxvii. 212.

turia in which a scruple of the extract of rhatany mixed with water was given three times a day. The ordinary routine of treatment had before been tried without benefit, but after the first dose of rhatany the hemorrhage ceased.[1] Rilliet and Barthez relate two cases of intestinal and *gastric hemorrhage* in new-born twin infants, in which enemata of a decoction of rhatany, and compresses soaked with the same and applied to the abdomen, did not appear to be of any service, although the children recovered.[2] This result may probably be ascribed to the administration of the medicine in decoction. In that form of *menorrhagia* which females describe by the phrase "being almost constantly unwell," and where the aggregate quantity of the discharge may not greatly exceed the common monthly amount, Dewees frequently succeeded in effecting a cure by means of two-drachm doses of the tincture of rhatany three or four times a day, or six grains of the extract with one or two grains of rhubarb, repeated at similar intervals.[3] The medicine had before been successfully used by Gardien and Ruitz. Dr. Levrat, of Lyons, made use of an extract prepared with alcohol and sulphuric acid, which is represented as possessing a highly constrictive and somewhat irritant action upon the stomach, and as peculiarly efficient in all forms of passive hemorrhage.[4]

The tonic property which rhatany appears to possess, as well as astringency, has caused it to be prescribed in cases of debility and exhaustion, from whatever cause. Tournel attributes to it the prevention of *miscarriage* in delicate women who had previously been subject to this accident. *Incontinence of urine*, a *scorbutic* state of the mouth, fever from atony, and *atonic dyspepsia*, are all of them said to have been successfully treated with this remedy.[5]

The *local* applications of rhatany are more general, if not more valuable, than its internal uses. One of the most important of these applications is in the treatment of *fissure of the anus*. As Trousseau remarks,[6] the ordinary treatment formerly consisted either in applying relaxing ointments, which were intended to overcome the constriction, or in preventing the constriction by dividing the sphincter muscle of the anus with the knife. But Bretonneau, observing in certain cases that the apprehension of pain prevented those who suffered with this disease from voiding the bowels, and that consequently the rectum became distended more and more with fæces, the mass to be discharged more voluminous, and therefore the pain in voiding it greater, considered that by restoring the rectum to its normal size and power he should promote the cure of the disease. He accordingly prescribed enemata made with a watery solution of rhatany and some of the tincture, and succeeded perfectly in curing this painful affection. But as further observation showed that in many cases of fissure of the anus no

[1] Lectures, 3d Am. ed., p. 903.
[2] Maladies des Enfants, 2ème éd., ii. 301.
[3] Diseases of Females, 3d ed., p. 153.
[4] Bull. de Thérap., xxiii. 319.
[5] MÉRAT AND DE LENS, Dict. de Mat. Méd., iii. 727.
[6] Thérapeutique, 5ème éd., i. 124.

constipation existed, and yet that rhatany effected a cure, it was evident that the preceding view of its operation could not be exclusively accepted. It must be presumed, indeed, that the astringent action of the medicine diminishes the afflux of blood to the part, and also directly as well as indirectly promotes the cicatrization of fissures by rendering the rectum and the anus less distensible by the efforts in defecation. The following mode of using rhatany in this disease is recommended by Trousseau. An emollient enema is administered every morning to empty the bowel, and half an hour afterwards a solution of a drachm or a drachm and a half of extract of rhatany in five ounces of water, with the addition of a drachm of tincture of rhatany is thrown into the bowel. A similar enema should be taken at night, and on both occasions it should be retained only for a moment. This remedy, with some modifications in the mode of applying it, rendered necessary by the peculiarities of individual cases, is nearly always successful. If the bowels, as usually happens, are confined, they must be kept open during the treatment by gentle laxatives and appropriate food. Trousseau advises, as the best laxative under the circumstances, from one-fifth of a grain to one grain of the powdered root of belladonna. The patient for whom this method is prescribed should be warned that his sufferings will, for the first two or three days, be aggravated by the more frequent necessity of going to stool; but this annoyance is usually temporary, and is followed by inexpressible relief. Moreover, the frequency of using the injections must be regulated by the ability of the patient to bear their repetition, and should gradually be diminished as the disease declines. Enemata of rhatany are also beneficial in the treatment of *dysentery*. In small quantity they are sometimes recommended to relieve tenesmus in this disease; but we have employed enemata of a pint of the infusion of rhatany with marked advantage, not only in alleviating the tenesmus, but in controlling the disease itself.

Marchal, Blache,[1] and Trousseau have also applied the solution of the extract to the treatment of *sore nipples*. The last-named physician prescribes, in addition, a thin paste made with the extract and white of egg, which he allows to remain in the fissures of the nipple, when they exist, taking care to wash the part each time before the child nurses, and to allow it to nurse as little as possible.

Dr. Detmold, of Hanover, states that he has never failed to cure ordinary *ozæna*, a chronic fetid and purulent discharge from the nasal passages, by means of an injection composed of from 60 to 120 grains of chloride of lime rubbed up in a glass mortar with thirteen ounces of decoction of rhatany root, and strained off after standing for half an hour.[2] It should be injected three or four times a day by means of a syringe, having a long canula or a piece of catheter attached. The defect of this, and all similar remedies is, that when the disease occupies, as it often does, the frontal sinus, it is entirely beyond the reach of an injection.

[1] Abeille Méd., i. 255.

[2] Brit. and For. Med. Rev., xii. 549.

Solution of the extract of rhatany has also been recommended as a collyrium in blennorrhœal *ophthalmia*, as a wash for mercurial and other forms of *stomatitis*, as a gargle in cases of relaxation of the *uvula* and pharyngeal mucous membrane, as an injection in *blennorrhœa* and *leucorrhœa*, and as an application to profusely suppurating and painful portions of the skin.

Administration.—The dose of *powdered* rhatany is stated at from twenty to forty grains, but this form of the medicine is seldom or never employed. The extract (EXTRACTUM KRAMERIÆ), is given in doses of fifteen or twenty grains. The *infusion* (INFUSUM KRAMERIÆ) made by percolation with one ounce of krameria and a pint of water, may be given in doses of two fluidounces. The *fluid extract* (EXTRACTUM KRAMERIÆ FLUIDUM) may be administered in doses of from thirty to sixty minims. The *tincture* and also the *syrup* of rhatany are officinal. The dose of the former is a fluidrachm, and of the latter half a fluidounce. For infants at the breast, the dose of the syrup is from twenty minims to a fluidrachm. It is often used in summer complaint, and kindred disorders, when there is no marked evidence of inflammatory action.

QUERCUS ALBA.—WHITE OAK BARK.

QUERCUS TINCTORIA.—*Black Oak Bark.*

Description.—The inner bark of the oak, a tree of which there are very numerous species, and which abounds in the temperate portions of the northern hemisphere, is everywhere essentially the same, but of the two officinal species, *Q. alba* is remarkable for astringency, and *Q. tinctoria* for possessing tonic qualities.

Quercus alba, or American white oak, furnishes a bark, which, when deprived of its epidermis, "is of a light-brown color, of a coarse, fibrous texture, and is not easily pulverized. It has a feeble odor, and a rough, astringent, and bitterish taste." It yields its active properties, which depend chiefly upon tannin and gallic acid, to water and alcohol.

Quercus tinctoria is so called because it yields a valuable yellow color, used as a dye for wool and silk. This coloring matter causes it, when chewed, to stain the saliva yellow. Black oak bark, or *quercitron*, as it is called in commerce, contains, besides tannin and gallic acids, a peculiar principle which combines with salifiable bases, and is called *quercitrin* or *quercitric acid.*

History.—Dioscorides says that all oaks are astringent, and refers to the inner bark as the principal seat of this property. The decoction of oak bark is useful, he remarks, in hæmoptysis and dysentery, and pessaries are made of it when bruised to restrain uterine hemorrhage. Bruised oak leaves, he adds, are used to cure inflammations and fortify relaxed parts.[1] Acorns were recom-

[1] Mat. Med., lib. i. cap. cxxi.

mended in similar cases, but as less powerful; and many of the ancient writers speak of them as being used for food. Pliny gives a very interesting account of the oak tree and its uses.[1] The Arabians chiefly describe acorns, which they say possess astringency, and that they are used for food, but are very little to be depended upon.

Action and Uses.—It is said that the bodies of animals that have had a certain quantity of oak bark mixed with their food for some time before being killed resist putrefaction in an extraordinary manner, and that tan is administered to animals threatened with gangrene after severe injuries. Hence it has been suggested, although the analogy seems a forced one, that large doses of this substance might possibly be useful in typhoid forms of disease.

Preparations of oak bark have been given internally in various *hemorrhages*, and in *chronic fluxes* of the bowels and bronchia, and even in *intermittent fever*, but they are seldom resorted to when other and more potent or appropriate remedies are at hand. An infusion of roasted acorns has been used in the atonic diarrhœa of children. Barbier was of opinion that the emanations of tanyards counteract the miasm of intermittent fever, and a similar notion has prevailed in regard to *tubercular phthisis*. Thackrah held this opinion regarding the latter affection, stating that, after careful inquiry at several tanyards, he could not hear of a single example of this formidable disease. He quotes also the statement of Dr. Dods, that he had "not been able to discover one unequivocal instance of death to have taken place in an operative tanner from phthisis, in its tubercular form, in any part of the kingdom."[2] Geoffroy remarked also that the workmen employed in tan-pits are rarely attacked with intermittent fever.[3]

Externally, decoctions and fomentations of oak bark have been used for all the purposes to which the other astringents are applied; in *prolapsus of the rectum*, *hæmorrhoids*, *leucorrhœa*, *relaxation of the mucous membrane of the fauces*, to promote the contraction of the *skin* over parts which have been unduly stretched, to prevent the formation of *bed-sores*, to heal flabby and ill-conditioned *ulcers*, and promote the separation and diminish the smell of *gangrenous parts*, and, finally, in a general bath, in cases of extreme *debility* with flaccidity of the tissues.

Administration.—The only preparation of oak bark which is administered internally is the *decoction* (Decoctum Quercûs Albæ), and even that but rarely. It is prepared by boiling an ounce of the bruised bark in a pint of water for half an hour, straining, and adding through the strainer sufficient water to make the decoction a pint. The dose is a wineglassful. A decoction made of double the strength of that just described should be prepared for external use.

[1] Hist. Nat., lib. xvi. cap. i. et seq.
[2] Effects of Arts, etc., on Health, etc , p. 61.
[3] Patissier's edit. of Rammazini, p. 441.

ROSA GALLICA.—Red Rose.

Description.—Two species of rose are recognized in the *United States Pharmacopœia*, *Rosa centifolia* and *Rosa Gallica.* The former, commonly called *hundred-leaved rose*, is chiefly used in the preparation of rose-water. Its petals are somewhat laxative in their action. Red roses are not extensively cultivated for medicinal purposes in this country. They are very abundant in the South of Europe, and particularly in France, whence the name of R. Gallica. They are also extensively cultivated in Germany and Holland. The petals are large, of a velvety appearance, and crimson color, and, when dry, have a grateful fragrance. Their taste is slightly astringent and somewhat bitter. Red roses contain tannic and gallic acids, volatile oil, coloring matter, etc. Their infusion has an acid reaction.

History.—The earliest mention of roses as a medicine is that made by Homer, of their being used at the time of the Trojan war. Several species are referred to in the Hippocratic writings, and the leaves are stated to be useful in uterine and other hemorrhages, and, when bruised, as an application to inflamed and ulcerated parts.[1] According to Dioscorides, roses are cooling and astringent. He describes a mode of extracting their juice to be used for inflamed eyes, and a preparation of the dried leaves in wine as a sedative and astringent application to these organs, to the ears, gums, anus, etc. He recommends a powder of dried rose-leaves for intertrigo, and says that an infusion of rosebuds confines the bowels and is useful in hæmoptysis.[2] Several varieties of the rose are mentioned by Arabian writers, as red, white, yellow, and even black. They report Persian roses to be the best, and describe them as of a dark color, powerful fragrance, and having thick-set petals. They assign to them the qualities already enumerated, mention a gargle made with roses boiled in honeyed water, say that they lessen intoxication, repress the venereal appetite, remove warts, heal ulcers and aphthæ, and correct fetor of the breath. Bruised rose-leaves are recommended as an application to inflamed eyes, and confection of roses as an internal medicine.[3]

Action and Uses.—Red roses have been used for the same purposes as the other medicines of their class, and even to cure pulmonary consumption. They are seldom prescribed at the present day, except in preparations which serve as excipients for other medicines. Although commonly regarded as astringent (and the unexpanded petals are really so), the full-blown flowers are, like those of the hundred-leaved species, slightly laxative. An *infusion* of rose-leaves is frequently prescribed with honey (Mel Rosæ), vinegar, etc., as a gargle, as a vehicle for the administration of sulphuric acid in hemorrhage, etc. The *compound infusion* (Infusum Rosæ Compositum) forms a useful solvent for the salts of quinia and the sulphate of magnesia, the taste of which it partially conceals.

[1] Dierbach, Arzneim. des Hippocrates, p. 80.
[2] Mat. Med., lib. i. cap. cxii. [3] Ebn Baithar, ed. Sontheimer, ii. 582.

Confection of roses (CONFECTIO ROSÆ) is the usual excipient of substances given in the pilular form, and which it is desired should speedily dissolve in the stomach. *Honey of roses* (MEL ROSÆ) forms an excellent detergent application to aphthous and other ulcerations of the mouth and fauces; and *syrup of roses* (SYRUPUS ROSÆ GALLICÆ) is employed occasionally as a laxative for infants in the dose of two fluidrachms. It may also be used as a coloring and sweetening ingredient of mixtures.

Rose-water is an agreeable excipient and solvent for collyria, but it possesses no medicinal qualities.

BUBUS.—BLACKBERRY ROOT.

Description.—This designation includes the roots of two indigenous plants which abound in the middle and southern portions of the United States, and are familiar to every one by their agreeable fruit. The blackberry (*R. villosus*) is a shrub of from three to six or seven feet high, and the dewberry (*R. Canadensis*) a creeping vine. Both bear compound round or conical berries, which are black when ripe, and consist of pulpy seed-globules, each containing a seed. The root of the former is woody, varying from an inch in diameter to the size of a straw, and is covered with a reddish-brown epidermis; while that of the latter is smaller, and is of a dark-grayish color. Their virtues reside in the bark, which is very astringent and somewhat bitter; they may be extracted by boiling water and by diluted alcohol.

Action and Uses.—These roots possess astringent and probably tonic virtues, and are much used in the *summer complaint* and *diarrhœa* of children as a domestic remedy. Usually a decoction is prepared by boiling an ounce of the smaller roots or of the bark of the larger roots in a pint and a half down to a pint of water, or sometimes of milk, according to the stage of the disease and the condition of the patient. Dr. Chapman says that to check the inordinate evacuations which commonly attend the protracted stages ef cholera infantum no remedy has ever done so much good in his practice. Some persons have claimed for it antilithic virtues. It may be used for internal hemorrhages in the absence of more efficient medicines. The syrup (SYRUPUS RUBI) is officinal, and may be given for the diseases just mentioned in the dose of one or two fluidrachms.

UVA URSI, vid. *Diuretics.*

Various other vegetable astringents have been used in medicine, such as Monesia, Bistort (*Polygonum bistorta*) Tormentil (*Tormentilla*), Marsh Rosemary (*Statice*), Plantain (*Plantago major*), Agrimony (*Agrimonia eupatorium*), Alum root (*Heuchera*), Hardhack (*Spiræa tomentosa*), Beech Drop (*Orobanche Virginiana*) Avens (GEUM VIRGINIANUM ET RIVALE), Persimmon (DIOSPYROS), etc. Indeed, of all the medicinal qualities with which plants are endowed, astringency is possessed by the greatest number. But those which have been described already, with some detail, will probably be found more than sufficient to meet the demands of medical practice.

Class III.

IRRITANTS.

The history of cutaneous irritants in medicine dates from at least the fourth century before the Christian era. Praxagoras, of Cos, prescribed warm foot-baths in head affections, warm cataplasms to the seat of pain in pleurisy, friction of the skin with vinegar, actual cautery of the nuchæ in epilepsy, and stimulating poultices and fomentations in dropsy. Eristratus, a century later, directed fomentations with hot water for sorethroat, and sponges saturated with cold water to control internal hemorrhage, and to prevent inflammation of the brain after exposure to the sun. Asplepiades advised frictions of the skin according to circumstances, with a rough or a smooth surface, with or without ointment or oil, and of various temperatures. He also made use of euphorbium and mustard, and of heat from fire. These, and still other irritants, were employed by Themison in the first century before the Christian era. To these remedies Celsus added caustic medicines for burning and eating into the skin, and prescribed blisters upon the shaven scalp for inflammation of the brain. He also proposed a theory to explain their action.[1]

As their name imports, irritants are medicines intended to irritate the part to which they are applied. They are conveniently divided into two classes, the first of which comprehends *rubefacients*, so called because they redden the integument by dilating its capillary vessels; the second comprises agents which are capable, more or less completely, of disturbing the arrangement of its organic constituents. These are *epispastics* (from σπαω, I draw), or blistering agents, which cause an elevation of the epidermis, with a secretion of serum beneath it, and *caustics* or *escharotics*, which destroy the organization of the tissues (from καιω, I burn; εσχαρα, an eschar).

The purposes for which medicines of this class are employed may be described by the terms irritant, counter-irritant, depletory, and escharotic. The first of these titles is generical, but it is also used in a more restricted sense, implying that the irritation produced

[1] Thierfelder, Prager Vierteljahrs., lxxvii. 1.

embraces the entire operation of the medicine, or at least the only one aimed at as a therapeutical object. Counter-irritation includes derivation and revulsion. Of the two latter terms, which were introduced by Galen, derivation implies that an irritation or discharge is produced in one organ, for the relief of another in a state of disease. This author describes revulsion as an operation tending to draw away a morbid action from its seat, having a downward direction in affections of the upper part of the body, an outward direction for those of the interior, etc. According to these definitions revulsion is merely a mode of derivation; but as both imply a particular mode of action which is assumed rather than proved, the term counter-irritation, which denotes the fact common to both, without involving any hypothesis, appears to be preferable to either.

Many irritants are to be found among internal remedies of the emetic, purgative, diuretic, and other classes. Sanguineous depletion, and especially local depletion, has also a derivative operation, partly by means of its irritant action, and partly in virtue of the laws which govern the circulation; but it has also an antiphlogistic influence, which entitles it, as a medicinal agent, to a place among sedative medicines, if it is not to be classed among surgical remedies. But many irritants are true depletives, although the fluid which they evacuate is not blood, but serum or pus, the discharge of which is hardly less operative as a remedial agent than the loss of blood itself.

Mechanism of Medicinal Irritation.—Irritant medicines are chiefly used to modify the vascularity and the nutrition of diseased parts, and especially to control congestion and the other elements of inflammation.

Inflammation is a disordered and exaggerated mode of nutrition. In both processes the same essential elements are concerned. The heat, redness, pain, and swelling, which characterize the former are simply the normal processes of the latter abnormally augmented and more or less modified in their phenomena by the causes which primarily occasion them, and by the state of the economy in which they occur. By a reference to the mechanism of inflammation, we are enabled to explain, in part at least, the curative action of irritant applications.

Inflammation consists essentially in the afflux of blood to a part, and the reactions which thereupon ensue. There is a stage of the process in which the affluent blood is contained wholly within the bloodvessels, where it stagnates. At this stage the oppressed organ struggles under its unusual load, and often unsuccessfully, unless spurred to extraordinary efforts by some stimulus from without. But under this impulse the accumulated blood is urged along its channels, the distended vessels contract, and the part returns to its normal condition bearing no trace of the violence it has undergone. But in the supposed case, inflammation has not been fully established, it is either of that form which is called erythematous, or it represents the congestive stage of the forms which tend to produce ulterior

changes. In the latter, effusion succeeds congestion. The liquor sanguinis escaping through the walls of the bloodvessels floods the adjacent cellular tissue, and there coagulates; to the redness, swelling, and heat of the first or congestive stage, succeed the greater redness, swelling, and heat, and the hardness and pain of the second stage of the process, and it now depends in a great measure upon the use of remedial agents how long the solidified effusion shall remain, and whether the destructive processes of suppuration, ulceration, or gangrene shall ensue. While the morbid deposit is recent, susceptible of absorption, and still prone to suppurative or other degenerations, the danger consists in an excessive activity of the molecular changes. To moderate these, and to restrict them within proper limits, the counter-irritant operation of the present class of remedies is invoked; for, under a law of the economy, an artificial inflammation acting at a certain distance from one of spontaneous origin, palliates the latter, and often, at the will of the physician, arrests its progress towards disorganization. Finally, if the exudation, whether strictly inflammatory, or owing to its close analogy with the products of nutrition, persists in such bulk, form, or position as to render its removal desirable, the class of irritant medicines affords agents which imitate the destructive processes above referred to, and by prolonged suppuration, or, more rapidly, by an escharotic action, reduce them to less troublesome dimensions, or destroy them entirely.

In the preceding remarks the most ordinary type of local inflammation, the phlegmonous, has been chiefly referred to. But inflammation is frequently characterized by extreme pain, by swelling, and by redness, although the effusion of plastic matter may be very slight or absolutely wanting. Such a form of disease is familiarly exhibited in rheumatism, which, even in its most active varieties, does not produce an organizable effusion in any degree proportioned to the amount of pain, heat, and swelling which it occasions, or one which at any time tends to purulent degeneration. Mobility from place to place is a characteristic symptom of this affection. A step further removed from typical inflammation, we find neuralgic affections presenting the element pain in its purest form, and often in its highest degree, and only exceptionally attended with swelling, heat, or redness. The peculiarities of rheumatic and neuralgic affections depend to some extent, no doubt, upon the fibrous and nervous tissues in which they are seated; yet both of these tissues are liable to changes produced by traumatic causes, which prove that they are susceptible of inflammation with all its ordinary phenomena. We must, therefore, conclude that rheumatism and neuralgia, while embracing inflammatory elements, do not derive from them their characteristic features. They, indeed, throughout the greater part of their course, manifest a facility of translation from one part to another which, while it proves the existence in them of a specific pathological element, independent of, or at least differing from inflammation, renders them peculiarly amenable to the action of revulsive agents, a chief condition of whose salutary

influence is the possibility of displacing the morbid process for the removal of which it is employed.

Theory of Counter-irritation.—The question in what manner an artificial congestion or inflammation modifies one which is of a morbid nature, is a problem which has at all times been investigated, but until quite recently without success. The objection was constantly urged to the most ingenious theories, that one spontaneous inflammation succeeding another in a neighboring part aggravates the latter as well as the general condition of the patient, instead of benefiting either. But this argument ceases to have weight when it is considered that the case in question is very far from being an analogous one to that in which an artificial irritation is produced upon a sound part for the relief of an organ which was previously diseased. In the former case, the very occurrence of the second inflammation is an evidence of the weakness of the system, and the cause of an additional loss of power. So neither does the occurrence of bed-sores in typhoid fever, and in all diseases of a typhoid type, nor the existence of the cutaneous eruptions in exanthematous affections, at all relieve internal derangements, because both the one and the other arise from the same morbid cause. It has, indeed, been suggested that the breaking out of an exanthema constitutes a sort of revulsive act, and in evidence of this opinion the subsidence of the febrile symptoms which coincides with the appearance of the eruption, has been pointed out. But the palliation of distress which then occurs might with more propriety be compared to the relief experienced in a limb on the removal of a band which had obstructed the circulation in its bloodvessels. The real action of the eruption is better seen when it has reached its maturity and a secondary fever is developed which is the direct effect of irritation of the skin, and one of the principal dangers of the affections in which it occurs.

But, apart from all theoretical or analogical illustrations of the subject, the fact is patent that secondary spontaneous inflammations aggravate, while artificial inflammations, duly regulated, palliate or cure those which arise primarily and idiopathically. How, then, we repeat, is this palliative or curative power exerted? Is it through the vascular system? Undoubtedly we see the blood retreat from the inflamed part, and accumulate in that to which the irritant is applied. "*Ubi irritatio ibi fluxus.*" But, between these two facts, no connection, save a mechanical one, is, at first sight, apparent, and that is insufficient to explain the phenomena. Or, if we invoke, as rightfully we may, the intervention of the nervous system, it still remains difficult to explain how the addition of a point of irritation should diminish an irritation already existing. Yet it is only by the laws of the nervous system that the difficulty can be solved. When we study the modes of nervous action, it soon becomes evident that it is never equally intense in two different points at the same time. We cannot attend to two perceptions at the same instant; whether they be mental ideas or sentient impressions, the stronger eclipses the feebler. This is so true that no fact

is more familiar than that a strong mental emotion renders us insensible to bodily pains, and that when several of the latter occur at the same time, the severest only is perceived. It is also well known that the mind is strengthened, and its organ, the brain, enlarged by mental exercise, at the expense of the nutritive functions of the body; and that the brain cannot long be powerfully exercised while a large demand is made for vital force by other organs, as those of digestion and locomotion. Thus the activity of the nervous system in one part diminishes its activity in others, and the vigor of the organic processes at the same time. And hence, as secretion and nutrition are directly dependent upon nervous influence, it is easy to understand how an irritation, capable of exciting the inflammatory process, should lessen the activity of a similar process in a neighboring part.

It is a familiar fact that the body is an assemblage of organs which are constantly exerting a reciprocal influence upon one another, so that all are more or less involved in the derangements of each, while every one at the same time has special relations which, when it is diseased, call forth a special group of sympathetic phenomena. The sympathies between the mammæ and the ovaries in the female, and between the testes and parotid glands in the male, are familiarly illustrated by the reciprocal transference of morbid states involving congestion from one of those organs to the other. It is an ancient method of treating amenorrhœa, to apply cupping-glasses to the breasts, and it is said that suction of the nipples in a pregnant woman will produce abortion. Examples of sympathy between remote parts, and exerted through the organ of the mind, are innumerable. Emotions of pleasure or shame suffuse the face with blushes, while fear and other depressing passions blanch the cheeks, chill the extremities, bedew the skin with a cold sweat, or even cause the fæces or urine to be voided. So emotions of pity or tenderness make the tears flow; the sight or even the idea of lascivious objects causes erection of the genital organs; the odor or sight of agreeable food, or even the thought of it makes the mouth water, while disgusting objects turn the stomach, and alarming ones suspend digestion or destroy the appetite. Equally striking illustrations drawn from disease may be adduced of the mutual inter-dependence of distant organs not so directly associated in function as those above alluded to. Obstinate constipation has been overcome by causing the patient to stand upon a wet marble pavement; phthisis has often supervened upon the cure of a fistula in ano, the suppression of an issue, or other habitual discharge; and, still more frequently, apoplexy and other internal congestions have followed the same causes. The translation of gout and rheumatism to the brain, heart, stomach, etc., when suppressed in the extremities, is familiar to every practitioner. No fact is better known than the congestion of internal organs by the application of cold to the surface of the body, and even to a very inconsiderable portion of it. The coryzas, and sore-throats and pulmonary catarrhs, diarrhœas and arrests of menses which arise from merely getting the feet wet, are matters of daily

experience, whose reality cannot be denied nor explained away. They are neither more nor less intelligible than the effects of counter-irritation, and both must be accepted because they are facts. The same may be said of the analogous effects produced by the exposure of the neck, the chest, or the abdomen to cold air. It is well known that such an impression upon the surface may be followed almost immediately by a rigor, and this, in its turn, by an inflammation of the throat, a catarrhal or inflammatory affection of the lungs, a colic, or an intestinal flux. So that we learn from these illustrations, among the many similar ones that might be adduced, that there is a lively sympathy between the external surface of the body, and the internal organs, and there can be no doubt that the simple observation of this relation first suggested the use of warm foot-baths and general baths, of cutaneous irritants, and of cups for the relief of such affections as are above referred to. There is just as little reason to doubt that such cases as these led to the more methodical employment of counter-irritation in those numberless cases in which every form of it, from the most transient and superficial rubefacient to the most permanent and spoliative exutory, has contributed to the relief of pain, to the removal of inflammation, and to the profound modification of nutrition in chronic diseases. Internal diseases are sometimes cured by the sudden and spontaneous outbreak of eruptions upon the skin, or by the formation of subacuteous abscesses. It is true that in some of these cases the existence of a material morbid element circulating in the blood is highly probable, but it is none the less certain that they illustrate one or more of the modes in which nature establishes revulsion.

Until very recently the mechanism of these interesting and important operations was entirely unknown. Hunter, in his interesting chapter upon "Repulsion, Sympathy, Derivation, Revulsion, and Translation,"[1] says that the second of these operations, sympathy, perhaps includes the mode of action of the rest. But this term, both etymologically and technically, expresses nothing more than the fact of a *consensus* between organs; it in no wise explains it. Modern science has penetrated more deeply into the secret places and actions of organized living matter. Since the discovery of the relations of sensation to motion through the nervous system, and the demonstration that separate nervous fibres convey in different directions sensory impressions and motor force, it has become evident that all consentaneous organic processes are conducted by and through the nervous system. Without this principle counter-irritation could not exist, and by its means most of the phenomena of this therapeutic agency are to be explained.

Some experiments of Naumann[2] illustrate, and perhaps demonstrate, the mode of action which is here claimed for irritants. A frog was killed by removing the head so as not to injure the medulla oblongata, the mesentery was exposed, and one thigh, after ligation

[1] Works, Am. ed., iii. 369. [2] Prager Vierteljahrs., lxxvii. 7.

of the bloodvessels, was separated from the body, leaving only the ischiatic nerve intact. On applying a mild galvanic stimulus to the web of the prepared extremity, and examining the bloodvessels of the mesentery at the same time, the current in its bloodvessels was observed to be quickened, and rendered continuous instead of wavy. But a stronger electrical force caused the bloodwaves in the vessels to grow more evident, and finally to be separated by distinct intervals. At the conclusion of the experiment the current of blood gradually resumed its original rate. Similar results were noticed when the action of the heart was studied. These experiments, which were repeated with various irritants other than galvanism, seem to confirm the statement already made that the influence of cutaneous irritation upon the circulation is exerted through the nervous system, and probably by a reflex operation.[1]

But essential as the sympathetic influence is to a comprehension of the effects of irritant remedies, it does not represent them all. If it did, every medicine might be substituted for every other one of the irritant class, due regard being had to its relative degree of irritant power. But it must be said of this as of every other class of the Materia Medica, that each individual composing it possesses properties peculiar to itself, either in degree or kind. While many produce effects which, even in their highest degree, are vesication or cauterization, others occasion neither of these phenomena, but a

[1] Some years ago (in 1862) (Prager Vierteljahrs., lxxvii., Analect., p. 70), the distinguished Professor Hebra, of Vienna, maintained that all counter-irritant measures are irrational, useless, and cruel; and although he did not furnish a single valid argument against them, his diatribe found an echo here and there. It was not, perhaps, strange that a physician exclusively devoted to the study of diseases of the skin should be imperfectly acquainted with a method of treatment adapted almost exclusively to internal affections. But it could not fail to excite surprise that a gentleman possessing the clinical experience of Dr. W. H. Dickinson should venture to assert, that "we have no reason to suppose that we can under any circumstances lessen an internal inflammation by exciting inflammation of the superincumbent, but disconnected skin" (St. George's Hosp. Rep., iii. 148); or again, that "we have no clinical evidence sufficient to assure us that a blister on the chest directs any special therapeutic influence to the lung, or upon the epigastrium to the stomach" (Practitioner, iii. 100); or that so accomplished a physician as Dr. Anstie should simultaneously pronounce a similar judgment (Lancet, Feb. 1869, p. 290). The papers of these gentlemen, it is true, contain facts and admissions enough to refute their thesis, while it seems probable that their apparent animosity against the doctrine of counter-irritation is their inability, in common with all pathologists, to explain it. Must we, urged by zeal for a false science which would measure truth by our capacity to comprehend it, try not only to seek reasons for every fact and doctrine, but also refuse to accept any as true if it is inexplicable? Must we fall back into that barren period of medicine in which whatever could not be vouched by Hippocrates or Galen was deemed incredible? Must we reverse the order of fruitful philosophical research and give to dogma precedence over fact? Shall we not remember that all truths are mysterious in direct proportion to their absoluteness, as life, light, and gravity, in the world of physics, and in the medical sphere the most definite diseases and the most certain remedies? Time may bring those now inscrutable truths within the range of philosophical analysis; but, meanwhile, to deny their reality because we are unable to explain them, is to degrade science and convict ourselves of a childish impatience without a childlike reverence for truth—that truth which is not in us that observe and reason, but in the things about which our reason and observation are concerned.

pustular eruption, which, again, may be of different kinds, as the ecthymatous or impetiginous eruption of croton oil differs from the umbilicated pustulation of tartar emetic. Of the action peculiar to the several caustics we shall have occasion to make additional remarks. A still more important difference, because it nearly concerns the specific mode of action of some of these medicines, is that which depends upon their absorption and the development of their characteristic operation. In the introductory chapter to this work instances were given of the absorption of medicines by the skin, both when the cutis is denuded and when the cuticle remains intact. The most familiar of the striking examples of this sort relates to cantharides, whose absorption from the skin, when it is used for blistering, is proved by the strangury which it occasions. The precise influence of the absorbed cantharidin as a therapeutical agent is perhaps not well established, but, as is elsewhere shown, this influence is viewed by a large class of writers as a sedative of the nervous and arterial systems. Turpentine and iodine may also be absorbed by the unbroken skin; and the preparations of mercury, tartarized antimony, and arsenic, even when thus applied, but more frequently when placed in contact with the surface of a wound or an ulcer, may develop the symptoms which are peculiar to them when taken into the stomach. The share belonging to this mode of action in the ordinary operation of irritants is not well ascertained, but that it is not inconsiderable in some cases may be regarded as certain.

Elements of the Counter-irritant Action.—It has been pointed out that one or more of the elements or of the effects of inflammation is involved in every case of treatment by counter-irritation. Each one also may become a special agent of cure. Sometimes pain alone, sometimes the congestion to which redness and swelling are due, sometimes a serous or purulent secretion, and sometimes a disorganization of structure is the efficient element employed. Each of these requires a separate examination.

Pain.—The cases are numerous in which the irritant action of pain is of great efficacy. Such are cases of narcotic poisoning, when mere revulsion would be inoperative, while agents which at the same time excite sudden and severe pain, such as urtication, flagellation, the application of hot substances to different parts of the body, are often successful in restoring sensibility. Other cases of insensibility produced by congestion of the brain have been cured by analogous methods. The moxa, vesication by boiling water or the hot iron, the actual cautery, faradization, etc., have been successful in relieving paralysis for which remedies less energetic and rapid in their operation have been resorted to in vain. The instances in which the pain of disease has been neutralized by pain excited as a counter-irritant are made familiar by daily experience; for it cannot be doubted that the efficacy of mustard and ammonia in assuaging the pain of inflammatory or even of venous congestion is quite as much attributable to the new sensation which

they excite as to their revulsive withdrawal of blood from the affected part. Even decided pain is not a necessary element of the derivative influence, as Hunter says: "I have known, in a nervous girl, a pain in one arm cured by rubbing the other." An illustration of the utility of pain as an element of counter-irritation is furnished by Dr. Beaufort.[1] A lady who was very subject to pulmonary congestion was often relieved by a blister either of ammonia or of cantharides, and the relief began as soon as the irritant began to burn. But as the lady was nervous and averse to suffer pain, on one occasion the skin was treated with morphia and chloroform before the revulsive was applied. The application was indeed painless, but it was also useless, and the patient was glad to obtain relief through suffering.

Congestion.—The congestive element of inflammation may be removed by irritation applied either directly to the inflamed part, or at a distance from it. The latter of these methods is counter-irritation or revulsion, the former is substitution.

Substitution is a method of cure which has at all times been practically recognized, although not always defined, nor even described. Thus, Hunter speaks of a mode of local cure "which is by producing an irritation of another kind," and adds that there "is in such modes of cure still a larger quantity of inflammation in the part than was produced by the disease." Again, alluding to the inefficacy of this method in the local treatment of constitutional affections, he remarks: "If the artificial disease is not of the same nature with the constitutional one, then it cannot act as a *substitute* for it."[2] This passage defines the doctrine and furnishes a name for the method treated of in the present article.

The therapeutical method of substitution is one of potent energy, but is adapted only to the early stage of inflammation, while yet the blood is almost entirely confined within its vessels, and before distension has impaired their contractility. The influence of diffusible stimulants in scattering, as it were, the earliest tendencies to internal congestion and inflammation is familiarly exhibited in the effects of alcohol and heat upon persons benumbed with cold and beginning to suffer pain in some internal organ. Thus, a draught of some alcoholic liquor frequently disperses the gathering elements of perhaps a fatal inflammation. The analogous influence of external heat, which belongs to the class of irritant medicines, is even more familiarly observed in the instinctive approach to the fire of persons who are the subjects of impending inflammation, a movement prompted by the sense of chilliness which precedes a complete stasis of the blood. That this influence is not to be measured by a mere elevation of temperature, but depends upon a vivid impression upon the nervous system, is proved by the fact that in frost-bite and in the cold stage of algid intermittents, cold applications, such as cold water or snow, employed with friction, are more useful than

[1] Bull. de Thérap., lxxvii. 11.

[2] Edit. cit., iii. 372.

such as are above the usual temperature of the body. In these and in all similar cases there is every reason to believe that the sensitive nerves stand in the same relation to the nerves of the bloodvessels as to the common nerves of muscular motion,[1] and that through these nervous relations all stimuli, whether by a direct or an indirect action, excite contraction of the bloodvessels, and thus produce the resolution of engorgements. But this, we repeat, is possible only so long as the blood is contained within its vessels, or, at most, when the effusion, if any, is still in a liquid state. When the exuded liquor sanguinis has solidified or is excessive in quantity, the application of stimulant agents, so far from promoting resolution of the inflammation, can have no other effect than to augment it, and render almost inevitable what else might have been avoided, suppuration of the inflamed part. This remark, however, is more applicable to parenchymatous than to membranous inflammations, because in the former the effused liquid is all retained, while in the latter it is for the most part discharged.

That a local stimulant treatment is successful chiefly in recent inflammations, is demonstrated by daily experience. Every day we see inflammations of the eye, nostrils, fauces, vagina, urethra, etc., arrested in their forming stage by the substitutive use of stimulant remedies; but it is unfortunately quite as common to witness the aggravation of such affections by the applications referred to, either because the period at which the inflammation was capable of dispersion had gone by, or because the strength of the stimulant was not duly proportioned to the susceptibility of the diseased part. It, therefore, becomes a very important problem in practice so to adjust the power of the application, and to employ it so opportunely that it may remove the original inflammation without exciting in its stead a still more intractable one. On the other hand, it is equally essential to the success of this method, not to suspend its application long enough to allow the primary disorder to resume its activity; for the latter may then return with renewed violence, and produce changes of so permanent a nature as to require a totally different management for their removal. It is also to be remembered that when an inflammation has for some time occupied the same part, the nerves become accustomed to its presence, the bloodvessels are permanently enlarged, the nutrition of the textures is affected, and consequently a much more powerful agent than at first is needed to restore its normal condition. This is familiarly illustrated by inflammation of the conjunctiva, which, in its first stage, readily disappears under the use of some mild stimulant, such as a very weak solution of wine of opium, or of acetate of zinc in water; but by degrees the inflamed membrane loses its susceptibility to such feeble stimuli, stronger solutions of the same agents are necessary, and at last, when a granular state of the membrane exists, nothing less than the sulphate of copper, the nitrate of silver, or

[1] Snellen, Virch. Arch., xiii. 109.

other powerful stimulant, will restore the healthy condition of the part.

But although it frequently happens that the stimulants employed are not strong enough to cure a local inflammation, it is quite as often observed that the morbid process is maintained and indefinitely prolonged by the protracted use of such remedies. No doubt this often arises from a change having taken place in the sensibility of the part. The first application of the stronger stimulants imparts a renewed vitality to the indolent tissues; but if their use is persisted in, they excite a new morbid condition of indefinite duration. On the other hand, their mere withdrawal allows the reparative forces of nature to act without hindrance, and the cure is completed. In the employment of stimulants for the cure of chronic inflammation, few rules of practice are more important than this: occasionally to suspend all treatment, and study the conditions and tendencies of the disease. Even when this intermission of remedies is not of itself sufficient for the cure, it enables us to learn what modifications of the method previously adopted will be apt to succeed.

The cases in which stimulant applications are made directly to an inflamed tissue, for the purpose of curing it, are exceedingly numerous. Nearly all primary inflammations of the skin and mucous membranes are of this sort, for, on examining the catalogue of remedies used in their treatment, we find very few that do not belong to the class of stimulants. In fact their employment has always formed a popular method of curing such diseases. The stimulant plan of treating erysipelas and burns was borrowed from the custom of managing them which prevailed among the colliers of England. Inflammations of the eyes, nostrils, mouth, fauces, vagina, urethra, and rectum, to say nothing of those affecting the mucous membrane of the respiratory organs, and of the stomach and bowels, are most frequently subjected to treatment by this method, which, when applied with judgment and discretion in regard both to time and degree, occupies the very first rank among therapeutic agents. We have said it is applicable almost exclusively to primary idiopathic inflammations. When it is used to cure external affections depending upon a vice of the system, it almost uniformly fails; as Hunter says, "being prevented from settling" upon the part to which the application is made, "they return upon the constitution again, and often fall upon some other part." This is the case with gout and rheumatism in their local manifestations, and often with diseases of the skin. In such affections the directly irritant teatment is seldom advantageous unless to recall to its original seat the morbid action which has gone to attack some more important and perhaps vital organ.

It was a distorted and exaggerated perception of the principle of substitution in the cure of disease that led Hahnemann to adopt it as an exclusive dogma, and to link with it another, the doctrine of infinitesimal doses, with which it has no natural or logical connection, and finally to burden those with the weight of a third article of faith, the hypothesis of "psora," which marks the anti-climax

of an ill-regulated mind in its natural descent from the impossible to the absurd.[1]

Under the title of *parenchymatous substitution*, Dr. Luton, a physician of Rheims, introduced a method which consists of injecting into the affected part various irritant solutions capable of exciting different degrees of action.[2] These he denominates respectively substitution by pain, by congestion, and by inflammation. The solutions of common salt, alcohol, nitrate of silver, and sulphate of copper, the tinctures of cantharides, and of iodine, have been employed by him in the treatment of neuralgia, glandular engorgements, strumous affections of the bones and joints, goitre, various tumors, etc. The results which he reports are worthy of attention. Some of them will be more particularly referred to in the article on nitrate of silver.

Revulsion.—Besides producing pain, irritants, as we have seen, by their influence on the nervous system, occasion an afflux of blood to the irritated point, and thus may be used *revulsively* to diminish congestion in overloaded organs. As the extent of surface of the skin upon which they act compensates for the inferior energy of their action, mild revulsives are often used with singular advantage when thus applied. This is strikingly true of warm water, em-

[1] The fact that, under appropriate circumstances, a cause competent to produce certain effects is also competent to remove them, has at all times been recognized by the popular as well as by the medical mind. The Latin poet, Syrus, writes, "Pro medicina dolor est, dolorem qui necat;" and in another place, "Remedio amaro amara bilem diluunt."

Baccius (*De Thermis*, p. 413) states that the following distich was inscribed upon the walls of the ancient baths :—

> "Balnea, Vina, Venus, corrumpunt corpora sana.
> Corpora sana, dabunt, Balnea, Vina, Venus."

In like manner the school of Salerno put forth a precept which is often too literally observed :—

> "Si nocturna tibi noceat potatio vini
> Hoc ter mane bibas iterum, et fuerit medicina."

But the most striking illustration of the doctrine that, under fitting circumstances, an artificial excitement will neutralize a morbid one of the same nature, is afforded by the following passages from Shakspeare, in whose writings there seems to be the germ of every description of knowledge :—

> "In poison there is physic : and these news,
> Having been well, that would have made me sick,
> Being sick, have in some measure made me well;
> And as the wretch whose fever-weakened joints,
> Like strengthless hinges, buckle under life,
> Impatient of his fit breaks like a fire
> Out of his keeper's arms ; even so my limbs,
> Weakened with grief, being now enraged with grief,
> Are thrice themselves."
>
> *Second Part of King Henry IV.*, Act I., Scene 1.

The well-known passage in *Romeo and Juliet* is to the same purpose :—

> "Tut, man, one fire burns out another's burning,
> One pain is lessened by another's anguish. . . .
> Take thou some new infection to thy eye,
> And the rank poison of the old will die."
>
> Act I., Scene 2.

[2] Archives Gén., Oct. 1863, p. 385.

ployed as a general or a partial bath in cases which demand a relief to the congestion of internal organs, or in which the remedy may be applied to one part of the body, in order to free a distant one from the congestion which constitutes the first stage of local inflammation. Thus, the foot-bath or hip-bath draws away the oppressive load which gorges the bloodvessels of the brain, the nasal cavities, the throat, chest, etc. If its temperature be no higher than is pleasant to the feeling, its action is limited to the effect described, but if it be in any degree painful, stimulation ensues, and the nervous system, instead of being soothed, is excited.

The effects of counter-irritation of a moderately high grade have already been pointed out as consisting in part of the stimulant action of pain. Within certain limits, which, of course, must vary with the natural susceptibility of the patient's constitution, or that which is impressed upon it by disease, this agency has been seen to exert a salutary influence. It may be further remarked that when a stimulus, which might operate beneficially upon a limited region of the body, is extended to a large portion of the cutaneous surface, its action may be such as completely and fatally to destroy all sensibility by the shock which it gives to the nervous system. In this manner, extensive burns and scalds, although slight in degree, frequently extinguish life after having annihilated sensibility in the skin.

Between the two extreme degrees of operation above referred to, may be considered those forms of counter-irritation which involve inflammatory elements, and may be accompanied with more or less disorganization, but which, by reason of their limited extent, do not inflict a great or lasting injury on the system. These forms include rubefacients, vesicants, setons, issues, etc., in a word, all agents producing a discharge from the skin, or a more or less permanent alteration of its structure. It is, in general, by their degree of concentration, and the duration of their contact with the integument, that they manifest their peculiar powers. By their means we may obtain a great variety of effects; simple derivation without pain, transient congestion, or this condition in a more permanent form, and accompanied with various degrees of pain from the most trifling to the most intense, and a more or less general excitement of the system. To these phenomena may be added vesication followed by exposure of the derm, and also destruction of the skin by ulceration or gangrene. In all of the latter cases the depletory operation of the irritant is the most important, for it not only diminishes the bulk of the circulating fluid, but also changes the direction of its pressure. It is best adapted to the cure of the results of inflammation, while congestive derivation is more efficient in the forming stages of this process.

In regard particularly to the method of revulsion or counter-irritation, the important fact is to be remarked that it exerts no influence whatever upon ulcerative changes of structure. It is also to be borne in mind that the degree of irritation usually required by this method would, if applied directly to the seat of inflammatory

disease, infallibly hurry it into disorganization by adding to the fixed effusion a fresh congestion and additional exudation matter. Its object may be only to draw away from the original seat of the disease a portion of that excess of activity which is urging it towards more permanent and serious changes; and to effect this object, revulsion establishes its operations upon a sound part, the best calculated by its position to control those actions which it is intended to remove. Too near, it must add fuel to the flame; too far off, it may inflict useless suffering. The precise position in which it should be placed can be determined by experience alone, and from this we learn that its distance from and relation to the seat of disease must be governed chiefly by the nature, extent, and intensity of the affection, and the sympathies of the organ involved.

In regard to the *nature* of the disease, it may be remarked that the method in question is hardly applicable to any case of inflammation, the cause of which is not confined chiefly to the affected part. Hence it exerts comparatively little influence upon the local, but essential, developments of idiopathic general diseases, whether fevers or dyscrasiæ. But it acquires its value anew in these affections in the treatment of the intercurrent or accidental inflammations, with which they are liable to be complicated. Thus it has much less influence upon the tonsillitis which accompanies scarlatina, than upon that produced by cold: less upon inflammation of the meninges, pleura, or peritoneum, arising in the course of phthisis, than when these affections have an independent origin. In such cases the counter-irritant treatment is not without a salutary influence, but it is very inferior to that which it exerts in idiopathic diseases of the same name. The reason of this inferiority evidently is that a cause is in operation tending constantly to maintain or renew the inflammatory action.

The *stage* of disease affects the utility of counter-irritant agents. We have seen that derivation by congestion is peculiarly applicable to the forming stage of diseases in which there is a local determination of blood; but, whenever this stage has passed, when effusion at the seat of disease has taken place, and the system, reacting under this stimulus and the concomitant change that affects the blood, and the general nutritive function, presents febrile phenomena, the use of counter-irritant applications is no longer opportune, and indeed, by adding to the excitement of the system, may greatly aggravate the disease. But when the intensity of the febrile action has subsided, and the pulse become softer and less frequent, without any threatening decline of the patient's strength, an appropriate moment for the use of counter-irritation has arrived. It is true that almost the only agent employed under these circumstances is cantharides, and that its influence upon the system is far from being represented by its counter-irritant effects. The other members of the class are almost entirely restricted in their use to cases of which fever is an accidental element, cases of chronic inflammation, or of departures from normal nutrition.

The *extent* of a diseased part affects the question of employing

counter-irritation for its cure. As a rule, the less the extent of the disease the more amenable it is to this mode of treatment. It is a most commonly used and efficient remedy for all local inflammatory affections of the organs of the special senses, the eye, the ear, the larynx, etc., and in all local pains and functional disturbances in nearly every other part of the body, including neuralgic, neurotic, and rheumatic disorders, and derangements of secretion. But its usefulness is not limited to cases of this description. The striking cures which have been made of inflammation of the membranes of the brain by using cantharides, tartar emetic, or croton oil as a counter-irritant applied to the entire scalp; the familiar examples of rapid cure by similar means of suffocative or of chronic bronchitis occupying the whole lining membrane of the lungs; the striking advantages of blisters covering the abdomen in some cases of peritonitis, hysteritis, and dysentery, do not permit us to entertain any doubt of the great, if not of the uniform efficacy of these remedies.

The *constitution* of the patient modifies the effects of counter-irritant remedies. As a general rule, persons of a nervous and irritable habit support them ill. Such persons have an exaggerated cutaneous sensibility, with a certain delicacy and fineness of the skin, which not only renders them intolerant of the pain, but very liable to the fever and general nervous derangement produced by these applications, and to excessive inflammation and even gangrene of the parts on which they act. These remarks apply to delicate females and young children, and hence extreme caution should be observed in their treatment by such remedies. The former are apt to be injured by the pain and excitement which result from it, the latter by an injury to the texture of the skin. In another place the liability of the integument to gangrene under the prolonged action of blisters will be pointed out, and its peculiar tendency to be affected with erythematous, vesicular, and pustular eruptions by the same cause. These eruptions are not always confined to the irritated surface and its immediate neighborhood, but may also appear in remote situations, a fact which it is difficult to explain without admitting the absorption of a certain portion of the irritant principle. This case appears to present a certain analogy to that which is sometimes observed as a consequence of vaccination, when similar eruptions make their appearance for the first time after this operation, and are apt to be attributed to the quality of the virus employed. In both cases there is great probability that the eruptions in question are due to some strumous or other vice inherent in the patient's constitution, and less frequently to some transient derangement of the system. However this may be, it is unquestionably the part of prudence never to apply any but the milder forms of cutaneous irritants to persons who have a fine and delicate skin with great nervous susceptibility, and especially to infants and young children.

The Depletory Action of Irritants.—Various irritants, in different grades of their action, produce a discharge of blood-plasma from

the integument. Wherever, then, an exudation exists in which pus is capable of forming, the blood is robbed of the most important elements of nutrition. Consequently the agents which effect this purpose are in a high degree depletory, and must tend to diminish the vigor of the system generally, and, in an especial manner, to hinder the nutrition of the organs upon which they more immediately operate. They act by drawing away the blood from neighboring parts, by means of the irritation which they excite. If a drain thus created affect the nutrition of the whole body, even in its soundest parts, much more must it influence those portions of the economy which are the seat of congestion by blood or exudation matter, and which, by the very presence of these, in a measure, foreign bodies, are deficient in tone and recuperative power. The establishment in their neighborhood of a serous or purulent discharge makes an unusual demand upon them to supply the loss, and necessarily the least organized elements within reach of the bloodvessels are first seized upon to repair the waste. This is a law of the whole system. It is familiarly illustrated by what takes place in partially consolidated fractures and wounds when any unusually exhausting influence comes into play. Then the callus or other provisional bond of union wastes away, and the surfaces of the solution of continuity are once more disunited. The contrary effect is exhibited when a seton introduced between the ends of a fractured and ununited bone, or an issue in the immediate neighborhood, occasions a deposit of callus and the solidification of the fracture.

The nature of the action exerted by irritants belonging to this category is evidently a double one, for it is revulsive as well as depletory. In acute diseases this operation is seldom invoked, except by means of blisters, which are powerfully revulsive if they are large and allowed to remain long enough upon the skin. But they at the same time abstract an abundance of serum, and afterwards of pus. The blistered surface is often prevented from healing, and made to furnish a large quantity of pus, by means of various irritating substances, such as mezereon, savine, resin, etc. But the more permanent forms of depletory revulsion are those in which a small wound in the skin is made to suppurate abundantly by means of mechanical irritants, as strands of silk and peas in the case of setons and issues, aided by some one of the medicinal irritants above alluded to. Formerly, more than at the present day, these agents held a high rank among remedial means, and they were regarded as affording apt illustrations of the truth of the humoral doctrines which then held exclusive possession of the medical world, inasmuch as they appeared to evacuate from the system the peccant humors which were supposed to circulate in the blood and constitute the material essence of diseases. The researches of modern pathologists, without having directly sanctioned this doctrine, have at least lent it some countenance by pointing out how much health depends upon an elimination of various deleterious because effete substances from the blood through the excretory organs. But, so

far as we are informed, there is no direct proof that any such excretion takes place, as a general rule, through artificial exutories. They discharge pus in various quantities, and containing variable proportions of the ordinary constituents of pus; and sometimes odorous and other substances, which are susceptible of elimination with the perspiration, are evidently mingled with the purulent secretion; but there does not appear to be any discharge by such outlets of the ordinary or extraordinary constituents of the bile or urine.

The diseases to the cure of which exutories are most applicable are chronic inflammations and habitual determinations of blood, whether or not they are associated with perverted nutrition. To enumerate these diseases would be to recite nearly the whole of the nosological catalogue, except idiopathic fevers, for there are few affections in which morbid determinations of blood and their consequences do not play an important part. It is of more moment, in this place, to indicate an objection to their use under certain circumstances. This does not refer to their transient employment, in the form of blisters, in acute disorders, but to their prolonged use in chronic affections, whether for the purpose of removing or of preventing local disease. The habit of spoliation which they establish can seldom be laid aside abruptly with impunity; its suppression is immediately followed by a plethoric condition of the system, and most usually the very organ for whose protection the exutory was established is the first to suffer from its suppression. This is familiarly and strikingly the case in cerebral disorders. No sooner is the revulsive and depletory action of the remedy suspended than congestion of the brain begins to take place, and, unless active means are taken to avert it, apoplexy is pretty certain to result. Hence it is, we repeat, that this form of revulsion, to be safely used, must be used cautiously, never established without sufficient cause, and never desisted from without the creation of some supplementary evacuations by depletion, purging, or diuresis, or else by hygienic means adapted to prevent the undue production of blood, and especially its accumulation in particular organs.

The Escharotic Action of Irritants.—Escharotics, or caustics, are substances which destroy the vitality of the part to which they are applied. In doing so, they necessarily produce the stimulant, counter-irritant, and depletory effects which have already been considered, and, in the case of issues, they are expressly employed to create a permanently suppurating point. Between the greater number of escharotics and other irritants there is this essential difference, that whereas the latter operate only by producing an exaggerated but still natural action, and which, when excessive, may result in the death of the part, the former act by combining with the elements of the tissues, and thus destroying their organization. The portion so destroyed, and which must then of necessity be cast off, is called an eschar. Escharotics, it is true, when sufficiently diluted, act as stimulants only; but in that case their mode of action is no longer the same, for they do not affect the integrity

of the tissues. Thus the most beneficent and familiar of all stimulants, caloric, becomes, when of a high degree, the most potent of escharotics, violently decomposing the ultimate organic elements of which the body is composed. A similar statement is applicable to alkaline, acid, and metallic caustics. In various degrees of dilution they become stimulants, rubefacients, vesicants, or escharotics; but in the last, we repeat, their mode of action is peculiar, for it cannot be admitted that between any condition short of disorganization, and disorganization itself, there is only a difference of degree.

Mr. Bastick has proposed a division of caustics into two classes, and the division appears to be well founded.[1] One class comprises those which merely kill the living tissue, as the chloride of zinc, sulphates of copper and zinc, bichloride of mercury, etc.; the other includes those which also decompose the tissue, dead or living, as caustic potassa, nitrate of silver, chromic acid, etc. Agents of the first class also become antiseptics or preservatives of the substance of the tissue whose vitality they have destroyed, while those of the second form new compounds out of its elements, as potassa does with the fibrin and albumen of the part. Hence, the latter are to be selected when a destructive operation is proposed.

The chief uses of escharotics are, to establish suppurating surfaces for the sake of their revulsive and depletory effects, to arrest hemorrhage, to open abscesses, to destroy tissues which are inordinately developed, although normal in their nature, to remove morbid "heterologous" growths, and to convert poisoned into simple wounds. As these various topics will be treated of in connection with the several articles of the escharotic class, it is unnecessary to dwell upon them here.

In concluding these remarks, introductory to the consideration of individual irritant medicines, we once more repeat the observation that every member of the class has powers peculiar to itself, which forbid the indiscriminate substitution of one of them for another. All are powerful medicinal agents, and each, in its appropriate place, is capable of rendering the most valuable aid in the treatment of disease. Two are pre-eminently useful, cantharides and nitrate of silver, since they are adapted to the treatment or a greater number of diseases than any others of the associated medicines. Two, which are also of great value, oil of turpentine and croton oil, are not treated of in the present division, but the former in the Class of General Stimulants, and the latter in that of Cathartics. The irritant properties of tartar emetic are described in the Class of Emetics.

Irritant remedies are derived from the three kingdoms of nature, and we propose thus to divide them, although here, as elsewhere, the several groups so constructed are not rigidly defined. Thus, ammonia is found in all three of the natural kingdoms, and soda, potassa, lime, etc., in at least two; while tartrate of antimony and potassa is composed of three elements, of which one is always of

[1] Times and Gazette, April, 1858, p. 371.

vegetable, and another of mineral origin. This classification is, however, a useful one, not only because it aids the memory in search of various agents of analogous qualities, but because these qualities often depend upon similar active principles in the organic, and upon similar chemical elements in the inorganic class.

IRRITANTS CHIEFLY FROM THE MINERAL KINGDOM.

ACIDUM ACETICUM.—Acetic Acid.

Acidum Aceticum Dilutum.—*Diluted Acetic Acid.*

Acetum.—*Vinegar.*

Acetum Destillatum.—*Distilled Vinegar.*

Sources.—Acetic acid is peculiar to the organized kingdoms, where it is found free in the juices of several plants, or else combined with potash, lime, or ammonia. According to some physiologists, it exists in the gastric juice, the milk, urine, and perspiration, but Pereira is of opinion that, in most if not all of these cases, lactic acid has been mistaken for acetic acid.

It is also a product of one of the forms of fermentation, hence called acetous. This is the source of common cider and malt vinegar. A similar but purer product is obtained by the fermentation of inferior wines. Thus, vinegar is defined : "the impure dilute acetic acid prepared by fermentation." Common vinegar contains about five per cent. of acetic acid, and furnishes by distillation the officinal *distilled* vinegar. For other than domestic purposes, it is obtained on a large scale by the acidification of alcohol, or the destructive distillation of wood. The purest acid is procured by decomposing acetate of lead by means of sulphuric acid, which combines with the lead, while the liberated acetic acid is removed by distillation.

Properties.—Acetic acid is a colorless, inflammable, volatile liquid of a pungent, fragrant, but sour smell, and a sharp acid taste. It unites with water in all proportions, and, to a certain extent, with alcohol. It evaporates gradually, and hence must be kept in closed bottles. It is wholly volatilized by heat.

History.—Vinegar appears to have been very anciently known. A part of the vow of the Nazarite was that he should "drink no vinegar of wine or vinegar of strong drink."[1] Hippocrates speaks of its use as a fomentation in injuries of the joints, in recent wounds and bruises, in certain cutaneous diseases, including the leprosy, warts, etc.[2] According to Dioscorides,[3] vinegar is refrigerant and

[1] Numbers, vi. 3. [2] De Humidorum usu. [3] Lib. v. cap. xvii.

astringent, agreeing with the stomach, augmenting the appetite, and suppressing hemorrhage. It may be used, he says, internally or externally. It assists digestion, and when applied on a sponge, or a pledget of wool, to recent wounds, it counteracts their tendency to inflammation. It restrains prolapsus of the rectum and navel, and fortifies spongy gums. It is a useful application to unhealthy and corrosive ulcers, and, associated with other medicines, is serviceable in various eruptions of the skin. Warmed and mixed with sulphur, it is beneficial in gout, and, associated with honey, may be used to disperse ecchymoses, and remove discolorations of the integument. As a lotion, it moderates heat of the head. Vapors of warm vinegar are serviceable in dropsy, in hardness of hearing, and in ringing of the ears. When dropped upon insects, in the auditory canal, it destroys them; it heals pannus, and is useful as a local application to the stings of venomous insects and the poisoned bites of animals. When mixed with salt and drunk warm, so as to excite vomiting, it is serviceable in poisoning by opium, conium, and poisonous mushrooms. Sipped or inhaled, it destroys leeches that may be hanging in the throat. It quiets chronic coughs, but aggravates the acute. Its warm vapor is a palliative in some forms of orthopnœa. As a gargle, it moderates excessive secretion in the fauces, and also relieves the quinsy and relaxation of the uvula. It palliates the toothache when used as a mouth-wash.

Galen declares vinegar to be injurious to the nerves, because it impoverishes the blood. He alludes to the irritant action of strong vinegar. According to Rhazes, vinegar thins the inspissated humors, dries the bowels, and assuages thirst. It is apt to produce flatulence, but excites the appetite, and quickens the digestion. It diminishes the seminal secretion when used immoderately, and prevents corpulency. Other Arabian physicians assert that it is hurtful to nervous, thin, and pale individuals.[1]

Action. *On Animals.*—According to the experiments of Mitscherlich, a rabbit, to which acetic acid had been administered, suffered from feeble respiration, great debility, and spasms, in which state it expired suddenly. One ounce of Prussian acetic acid killed a large rabbit in seven minutes; half an ounce killed a small one in eleven minutes; two drachms another in an hour and a half; and one drachm another in about four hours. The dose of half a drachm did not cause death. In his experiments with distilled vinegar, he found that six drachms killed a small rabbit in eight hours, and that half an ounce did not cause death. The tunica propria of the intestines was found softened, and of a brownish-red color.

On Man.—The local action of acetic acid is that of an astringent and stimulant. In a concentrated form and applied to delicate and sensitive tissues it is very irritating and almost caustic. When diluted it penetrates the epidermis without dissolving it, and by

[1] Ebn Baithar Heil- und Nahrungsmittel, i. 377.

this means may be absorbed into the system. In moderate quantities and sufficiently diluted, and not too frequently used, it increases the appetite and facilitates digestion, as ancient writers affirmed of it, and quenches the thirst. According to Vegetius, the Roman armies, during their campaigns in the East, carried with them a stock of vinegar with the twofold object of relieving the soldiers' thirst when the weather was very hot, and of preserving them from intermittent fevers.[1] But employed incautiously it weakens the digestive powers, though less than the mineral acids do, and sooner or later induces eructation, heartburn, loss of appetite, diarrhœa, emaciation, and debility. According to Morgagni, it may occasion thickening of the coats of the stomach. The injurious influence of vinegar on the nutrition of the body is shown in the following case, related by Portal.[2] "A few years ago, a young lady in easy circumstances, enjoyed perfect health; she was very plump, had a good appetite, and a complexion blooming with roses and lilies. She began to look upon her embonpoint with suspicion, for her mother was very fat, and she was afraid of becoming like her. Accordingly she consulted a woman, who advised her to drink a small glass of vinegar daily; the young lady followed her advice, and her corpulence diminished. She was delighted with the success of the remedy, and continued it for more than a month. She then began to have a cough, but it was at its commencement, and was considered a slight cold which would go off. Meantime from dry it became moist, a slow fever came on, and a difficulty of breathing; her body grew lean and wasted away; night-sweats, swelling of the feet and of the legs succeeded, and a diarrhœa terminated her life. On examination, all the lobes of her lungs were found filled with tubercles which somewhat resembled bunches of grapes." An instance of the same sort is related by Desault.[3] Foderé tells us[4] that in Germany there was a sort of quacks who professed to relieve persons who suffered from inordinate obesity. They prescribed large doses of vinegar for the purpose, and if they sometimes fulfilled their promise, it was at the expense of disorders which sooner or later put an end to their patients' lives. Sundelin affirms that the workmen in vinegar factories acquire a cachectic look, and soon become consumptive. I saw, says this writer,[5] in a family that lived hard by a manufactory of vinegar, three of the children die successively of a phthisical inflammation of the lungs; and two others who were already diseased were only preserved by a timely removal. This fact would appear to be an exceptional one, for Pereira, who inquired among the workmen in a large vinegar factory in London, found the notion of the injurious influence of the vapor generally repudiated by them.

An attempt has been made by modern chemists to explain the effects of acetic acid. According to some, on its passage into the

[1] Pringle, Diseases of the Army, p. 112. [2] Lond. Med. Gaz., April, 1839, p. 176.
[3] Mérat and De Lens, Dict. cit., i. 28. [4] Dict. en 60 vol. lviii. 132.
[5] Handbuch der Spec. Heilmittel., 3te aufl., i. 73.

blood, it is converted into lactic acid. It is thought to act chemically on the food and cause its solution, for it is undoubtedly a solvent of fibrin, albumen, and gelatin, the chief constituents of animal food. Its tendency to produce emaciation and its power of moderating vascular action are also attributed to its solvent action on the fibrin of the blood. Its faculty of assuaging the thirst is ascribed to its augmenting the secretion of the salivary and the mucous glands.

As regards the poisonous effects of acetic acid, they are so seldom witnessed that, as Mr. Taylor remarks, this acid has generally been excluded from the class of poisons. A case is cited by Orfila, however, in which decidedly toxical symptoms were manifested.[1] A person who was recovering from an attack of pneumonia swallowed a spoonful of strong acetic acid. He shrieked with pain; the interior of his mouth was whitened, and his thirst intense; there was a burning pain in the chest and abdomen, nausea, and subsequently vomiting and diarrhœa, inability to speak, profuse sweating, and a small quick pulse. Notwithstanding the feebleness of the patient when the accident occurred, he entirely recovered. There does not appear to be any case on record in which this acid was unequivocally the cause of death. In another case a drunken man swallowed two or three fluidounces of a liquid containing 33 per cent. of anhydrous acetic acid, some of which apparently entered his larynx. He fell to the ground apparently insensible, and foaming at the mouth; but he remained conscious and did not complain of pain, but appeared to have great difficulty of breathing, caused by the laryngeal obstruction. His skin was cold; pulse 55 to 60; lips and mouth not inflamed or corroded.[2] In spite of asphyxia produced by the introduction of the stomach tube, and the operation of laryngotomy performed to remedy these mishaps, the man recovered.

The recommendations of modern writers, touching the dietetic use of vinegar, do not differ essentially from those of the ancients, which have already been quoted. It is appropriate for persons who are not very thin nor irritable, and especially in warm weather, or along with a fatty or a crude vegetable diet; but it is to be avoided when the digestion is weak, and when there is a tendency to colic and diarrhœa. Anemic and chlorotic females should sedulously abstain from its use, although they have sometimes an insatiable longing for it. Nursing mothers, also, ought to partake of it sparingly, for cases have occurred of fatal diarrhœa in the infant arising from acidification of the breast-milk by this article.

Remedial Uses. *Internally.—Fevers.*—Owing to its liability to produce colic and diarrhœa, acetic acid is much less generally used than other vegetable acids, particularly lemon-juice, and less even than the mineral acids. It may, however, be prescribed in febrile affections generally, but the symptoms which especially indicate it are heat of skin and excessive thirst. By moderating the fever it

[1] Toxicologie, i. 258. [2] Lancet, July, 1867, p. 98.

palliates these symptoms, and when much jactitation exists, tends to promote calmness. The most general application of the remedy to this class of diseases has been in *typhus*, *scarlet*, and other malignant fevers, owing to its supposed possession of so-called antiseptic virtues. Mindererus, Diemerbroeck, and, to some extent, Pringle,[1] supported this opinion, but there is nothing to prove its validity. It palliated the fever, as already explained, but nothing more.

The employment of vinegar vapors as a means of destroying *contagion* is an ancient method which has but recently been superseded by the use of chlorine. Vinegar was sprinkled over the floor and furniture in sick rooms, or its vapor was diffused from hot iron, from live coals, or from cloths hung near the beds of the sick. It is now, or it very recently was, the custom in the Mediterranean ports of Italy, France, Spain, etc., to subject letters received from the Levant, when the plague prevailed in that region, to a thorough fumigation with the vapors of vinegar.

Hydrophobia.—A large number of reports have been published of the cure of hydrophobia, from the bite of a mad dog, by means of large draughts of vinegar, injections of the same, baths of its hot vapor, etc. It is not possible either to affirm or deny the truth of such statements, but all recent experience tends to deprive them of credit.

Narcotic and other Poisoning.—Vinegar has been regarded as an antidote to almost all poisons, but to those of the narcotic class especially, including stramonium, belladonna, strychnia, and opium. On the other hand, this doctrine has been rejected by the most eminent toxicologists. It would seem that a distinction is to be made. Experiments upon animals do not show that acetic acid diminishes the violence of the symptoms occasioned by narcotic poisons, but rather the reverse. In the human subject, too, its effect is decidedly injurious. Thus, for example, in a case of poisoning by opium, quoted by Mr. Taylor,[2] vinegar was given in repeated doses, but served only to increase the stupor and other bad symptoms. But if the stomach have first been freed from the unabsorbed narcotic, so that the acid no longer facilitates its action by dissolving its poisonous principle, the stimulant operation of the former may prove salutary. The Rasorian school, while insisting on the antagonism of vinegar to opium, maintain that it augments the poisonous action of conium, belladonna, strychnia, and the acro-narcotic agents generally.

In poisoning by the *caustic alkalies* and *earths* and their carbonates, acetic acid or vinegar is the proper antidote, because it forms with these substances innocuous acetates. These acids have both been used with decided advantage to allay the severe abdominal pain of *lead colic*, particularly when a partial evacuation has been procured by purgatives. In some cases the acid appears to have determined the action of the cathartic medicines administered.

Vinegar is said to have the power of dissipating the *intoxication*

[1] Diseases of the Army, p. 267. [2] Med. Jurisprudence (Am. ed.), p. 487.

produced by alcohol, but we do not find it recommended by those who have treated professedly of this subject. The same remark may be made of the use of vinegar in *mania*. In *scurvy*, this acid would seem to have been but little used. Dr. Kerr says it appears to have exerted little, if any, power over the disease, unless associated with nitrate of potassa.[1] It was recommended by Haller as a remedy for *obesity*, but, as already shown, its mischievous effects more than counterbalance its advantages.

Acetic acid and strong vinegar have long been used as stimulants to the olfactory nerves and the Schneiderian membrane, to calm agitation, relieve *headache*, dispel *faintness*, and prevent infection. A perfume, made by distilling vinegar with various aromatics, and with camphor, is a favorite preparation of the sort in France. It is known as *vinaigre des quatre voleurs*, a name which it derived from an incident during an epidemic of the plague of Marseilles. It is said that four thieves, who went plundering from house to house, escaped the contagion of the disease by constantly smelling at the preparation to which their adventure gave a name.

Crystals of sulphate of potassa, impregnated with acetic acid and some aromatic essence, may be inclosed in bottles, for the same uses as ordinary smelling salts. The emanations of acetic acid have been used as a stimulant to arrest the development of *coryza*. Ammonia and the terebinthinate preparations answer the same purpose.

Externally.—In *fevers* of a typhoid type, with languid capillary circulation, a doughy feel of the skin, and profuse sweats, vinegar may be applied to the whole body, or only to the extremities and face, and either cool or warm, according to the temperature of the skin, and of the air. This lotion, if very acid, acts as a stimulant, but when much diluted, and applied to the hot, dry, and injected skin of patients laboring under typhus or scarlatina, it appears to be more efficient than aqueous lotions, in lowering the temperature of the body and quieting restlessness.

This acid is very beneficial in passive *hemorrhages*, and in those depending upon an altered state of the blood, particularly in hæmoptysis, hæmatemesis, and uterine hemorrhage. For epistaxis, it may be employed by snuffing into the nostrils, or, better, by laying thin compresses, wet with vinegar and water, upon the exterior of the nose. In other hemorrhages there is no comparison between its efficacy and that of the acetate of lead. In bleeding from the womb or lower bowels, it may be applied directly by injection, or, in the former case, by means of a tampon, or in a sponge introduced into the uterus in post-partum hemorrhage, while its contents are expressed by the hand. Cloths, wet with vinegar and water, are laid upon the adjacent parts, to produce cold by evaporation. In a case of uterine hemorrhage after delivery, caused by the prolonged adhesion of the placenta, Mojon injected very cold vinegar and water by the umbilical vein. The contractions of the uterus were at once aroused, and the hemorrhage ceased.

[1] Cyclopædia of Med., iii. 697.

A mixture of vinegar and water is of universal use as a local application to *bruises*, *sprains*, superficial *wounds*, *fractures*, and limited inflammations. It should be applied to the part, upon lint or charpie, as soon as possible after the injury has been received, and before the signs of inflammation manifest themselves, so as to prevent, by its evaporation, the occurrence of swelling, ecchymosis, etc. The addition of a small quantity of alcohol to the mixture will render it more efficient. This method is particularly useful in injuries to the head; for it not only moderates the external inflammation, but also protects the brain from this process, and from congestion. The lotion should be applied to the shorn or shaven scalp. In superficial *burns*, lotions of vinegar and water afford sensible relief, but not so much as the exclusion of air by means of raw cotton. They are also very efficient in preventing the development of *milk abscess*.

Compresses wet with vinegar and water, and bound upon the temples, palliate the pain of *headache*, both of the inflammatory and the neuralgic forms. A weak mixture of the same kind may be instilled into the *eye*, to remove particles of lime adhering to the conjunctiva. Involuntary *seminal emissions* have sometimes been arrested by applying a sponge, wet with strong vinegar, to the perineum, and maintaining it in that position for several hours. This result, it may be surmised, depends chiefly upon the counter-irritant effect of the vinegar, yet, in some degree, also, upon the refrigerant action of the liquid when first applied.

Strong acetic acid has been used to soften and remove *warts*, *corns*, etc., which it does by its affinity for the albumen of which they are composed; it has also been employed to *blister* the skin, but cannot be recommended for this purpose. As a lotion in ringworm of the scalp (*porrigo favosa*, *favus*), it is of great service; according to Pereira, one or two applications of it usually suffice to effect a cure. In a diluted form it soothes the intolerable itching of *psoriasis* and *lichen*. Clysters of vinegar have been recommended for the destruction of *ascarides* of the rectum.

In 1866 Dr. Broadbent proposed to destroy cancerous tumors by injecting acetic acid into their substance. He was led to make this suggestion by the fact that in microscopic investigations acetic acid is employed to dissolve cancer cells, by the feebly disorganizing action which this liquid exerts upon the healthy tissues, and by its inability to coagulate albumen. The last circumstance is important, because it secures the diffusion of the acid among the cells of the cancerous tumor. Several cases seemed to attest the efficacy of the method when appropriately employed, and show that a cancerous tumor submitted to it will sometimes shrink and dwindle, and ultimately cease to show any activity. On the other hand, if the acid employed was too strong, or the injections were too frequently repeated, phlegmonous inflammation ensued. It seems, also, that the injections cannot be expected to avail if the skin is ulcerated so as to allow the acid to escape.[1] The degree of success claimed for

[1] Times and Gazette, Sept. and Nov. 1866.

this ingenious method of treating so intractable a disease naturally led to its being imitated both in Europe and in this country; but the results proved that the expectations entertained of its value were altogether illusory, and that a remedy for cancer has not been found in acetic acid.

Administration.—As an internal medicine good wine vinegar should always be preferred. The product of the distillation of wood sold for culinary purposes, is both disagreeable and unwholesome. The *dose* of vinegar is from one to four fluidrachms; that of Diluted Acetic Acid (*Acidum Aceticum Dilutum*) is nearly the same. One or two fluidounces of vinegar may be given by enema. To form an acidulated drink, from one to two fluidounces of vinegar may be mixed with a quart of water. A lotion may be prepared by mixing two or three fluidounces of vinegar with five of water.

ACIDUM NITRICUM.—Nitric Acid.

Acidum Nitricum Dilutum.—*Diluted Nitric Acid.*

Sources.—Nitric acid exists in nature combined with potassa, soda, lime, and magnesia. It is sometimes free in spring water, and, according to Liebig, in rain water after thunder-storms.

It is procured artificially by distilling in a retort a mixture composed of equal weights of nitrate of potassa and sulphuric acid. When perfectly pure it is colorless, but it has usually a slight yellowish tinge, due to the presence of nitrous acid developed during the progress of distillation, or subsequently by the decomposing action of light. Its sp. gr. is 1.420. *Diluted nitric acid* is made by adding to three troyounces of nitric acid a sufficient quantity of distilled water to make the diluted acid measure a pint. Its sp. gr. is 1.068.

History.—Some writers attribute its discovery to Raymond Lully, but others carry it back to the seventh century. It was first analyzed by Cavendish in 1785.

Action. *On Animals.*—In even its most concentrated form nitric acid acts much less energetically than sulphuric acid upon the animal functions and tissues, but the symptoms produced by the two acids differ in little but degree. The most important distinctive character of nitric acid in this connection is that, when swallowed, it does not, like sulphuric acid, coagulate the blood. If injected into a vein, it has indeed this effect, but only partially. In one of Orfila's experiments the left ventricle of the heart contained two large gelatinous-looking clots of a dusky-red color, surrounded by a small quantity of like-colored serum, and the large bloodvessels of the thorax contained liquid blood.[1] Viborg injected a drachm of fuming nitric acid, with three drachms of water, into the jugular veins of two horses. Immediately afterwards they were

[1] Toxicologie, i. 163.

lively and breathed quicker, and the pulse was more frequent. These symptoms were followed by signs of depression, which passed away in the course of two hours. At this time some blood was drawn; it coagulated readily, and had but little buffy coat.[1]

On Man.—The symptoms occasioned by concentrated nitric acid are almost identical in kind with those of sulphuric acid, since they mainly depend upon the destruction of the tissues to which the liquid is applied. But the caustic action of the former is much less rapid and profound than that of the latter. Another striking difference is the peculiar color of the integument stained by nitric acid. Although the stain is white at first, it soon becomes orange-yellow, and upon the mucous membranes brown, owing probably to the action of the alkali contained in the salivary and other secretions. The recent stain of iodine which bears some resemblance to that of nitric acid, differs from it in being removable by caustic potash and by ammonia, whereas the other is permanent. The enamel of the teeth is rendered very white, and is partially destroyed by this acid. In a case fatal on the eighth day after the ingestion of a teaspoonful of the strong acid, the usual lesions were found in the mouth, fauces, œsophagus, and stomach, but although the small intestine was sound, the colon was intensely and deeply ulcerated. There had been complete suppression of urine.[2] Administered internally, and in small doses, diluted nitric acid exerts at first a tonic action, increases the appetite, and augments the flow of urine. It generally produces a white coating on the tongue, and dryness of the mouth. Sometimes, after a few days' employment of it, the teeth begin to grow loose, and the gums to bleed. At the same time the flow of urine increases. Its longer employment occasions dyspepsia, colic, foul breath, headache, feverishness, debility, and constipation or diarrhœa. A small pustular eruption sometimes appears upon the skin. Bateman, who gave the acid in a diluted form for hepatic derangement, found that it produced salivation, but neither fetor of the breath nor ulceration of the gums. But all of these symptoms existed in several of the cases reported by Prioleau.[3] This salivation would appear not to depend upon the local action of the acid, if we may accept the statement of Richter, who found the same effect produced by nitric acid baths. According to Clarus, it is less refrigerant, and relieves the thirst less than sulphuric acid, and is less stimulating than hydrochloric acid.

Uses. *As an Disinfectant.*—About the close of the last century Dr. Carmichael Smith drew general attention to the effects of nitric acid vapors in preventing or destroying contagion, particularly that of *typhus*, or jail-fever as it was commonly called. Its apparent efficacy in staying the advance of epidemics of this disease, induced the British Parliament to reward the proposer of the method with £5000. Experiments were made with the nitrous fumigations, as they were termed, in various parts of Europe, and the verdict in

[1] Wibmer, Wirkung, iii. 351.
[2] Arch. d. Heil., iv. 183.
[3] Vid. infra.

their favor was nearly unanimous. Hospital wards, in which were patients suffering under typhus, dysentery, gangrene, and even yellow fever, were fumigated, and almost always with apparent advantage. In Seville, it was even alleged that in whatever house or ward this method was practised, no more persons died or fell sick. Dr. Smith directed the vapor to be prepared by mixing equal parts of sulphuric acid and saltpetre together in a saucer placed upon hot sand, and to be used for two hours morning and evening. However effectual it may have been in destroying contagion, the plan was found to have serious inconveniences. The vapor had a very irritating effect upon both patients and attendants, producing cough and an abundant secretion of mucus from the lungs and throat, and sometimes hæmoptysis or diarrhœa, besides filling the wards or chamber with a sour smell. It was undoubtedly useful, however, in correcting the foul odors of the sick, and perhaps, also, in neutralizing the infectious effluvia. It might still be resorted to as a convenient substitute for chlorine.

Internally.—In *fevers* of a malignant or typhoid type, it was prescribed by Hoffmann and others. Ferriar regarded it as almost a succedaneum for cinchona in *typhus fever*, and although many have advocated its use, in this disease and in scarlet fever, its utility must be considered as very questionable.

This acid was first discovered to possess antiperiodic qualities by Dr. Bailey, of Indiana,[1] while he was administering it to counteract profuse night-sweats in a case of chronic *intermittent fever*. Ninety cases were treated by its means, seventy-five of which presented the quotidian, and fifteen the tertian type. All in which the medicine was faithfully administered, eighty in number, recovered promptly. From six to eight drops of commercial nitric acid, properly diluted, were administered once in six hours, without regard to remissions or exacerbations. Dr. Coons, of Dayton, O., treated thirty-six cases with a like degree of success,[2] which was confirmed by the report of Dr. W. H. Hammond, upon thirty-three cases of intermittent fever occurring at Fort Riley, Kansas. He found it altogether as efficient as quinia in arresting the disease when prescribed in doses of ten drops largely diluted, three times a day.[3] An equal degree of success attended its administration, in *remittent fever* of an adynamic type, by Dr. Bedford Brown, of N. C.[4]

The favorable reports by Hope,[5] of the effect of fuming nitric acid in the treatment of *cholera*, *dysentery*, and *diarrhœa*, obtained, at one time, quite an extensive popularity for the mixture he employed. But subsequent experience has not confirmed the opinion he entertained of its efficacy.

Dr. Arnoldi, of Montreal, proposed nitric acid as almost a specific remedy for *whooping-cough*, and his recommendations have been

[1] Am. Journ. of Med. Sci., Oct. 1854, p. 581.
[2] Ohio Med. and Surg. Journ., 1857.
[3] Maryland and Virg. Med. Journ., Feb. 1861.
[4] Am. Journ. of Med. Sci., Jan. 1860, p. 43.
[5] Edinb. Med. and Surg. Journ., xxvi. 35.

sustained by Drs. Gibb,[1] Witsell,[2] Atcherly,[3] Noble, and others. Under its use the violence of the paroxysms is said to be greatly mitigated, and the duration of the disease abridged by more than one-half. Arnoldi directed as much acid to be added to a tumblerful of very sweet water "as would bring it to the strength of pure lemon-juice," and this was stated as the quantity an adult should consume in three or four hours. For a child one year old, the dose was a dessertspoonful of the mixture every hour. Dr. Gibb directed fifteen drachms of diluted nitric acid, in an eight-ounce mixture, of which two or three drachms were to be given every hour or two, which is more than half a drachm of the acid at each dose! Mr. Atcherly prescribed five minims every three hours for a child six months old, and gradually increased the dose to fifteen minims every second hour. The medicine was continued for some time after the cessation of the paroxysms, and for children who have teeth, a gargle composed of two drachms of carbonate of soda dissolved in eight ounces of water, was directed after each dose. This treatment is probably now obsolete. In *chronic bronchitis* with exhaustion of the system, and a frequent, harassing, and paroxysmal cough, Dr. Glover derived material advantage from the exhibition of ten minims of diluted nitric acid, and twice that quantity of spirit of nitrous ether, every six hours.[4] Five or six drops of nitric acid in a glass of sweetened water, taken twice a day, has been highly recommended for the removal of *hoarseness* in singers.

Nitric acid was greatly extolled by Alyon in *syphilitic eruptions* of the skin, and subsequently by Beddoes and by Scott as a specific in venereal complaints. The last-named writer inferred from his observations that the action of the acid resembled that of mercury, and hence he recommended it in the treatment of syphilis. A large number of physicians in England, and on the continent of Europe, employed it in both primary and secondary syphilis, and in this country no less flattering statements were made of its efficacy by Prioleau.[5] He used it in primary as well as secondary syphilis, and with very satisfactory results. In almost every case it produced ptyalism, and in several swelling of the submaxillary glands. Hutchinson found it almost useless in primary syphilis, but a majority of cases of ulcers in the throat, eruptions on the skin, and periosteal swellings, were cured by its use.[6] Ferriar[7] did not estimate its effects so highly as many other physicians did. He thought its power limited to certain specific symptoms in the advanced stages, such as pains in the bones, and superficial ulcers.

These results, when attentively examined, do not afford sufficient ground for attributing an antisyphilitic virtue to the medicine. The cases in which it seems to have been most decidedly useful were those of chronic syphilitic ulcers of the gums, of general

[1] A Treatise on Hooping-Cough, Lond., 1854.
[2] Chast'n Med. Journ., xii. 84.
[3] Times and Gaz., Feb. 1859, p. 210.
[4] Lancet, Mar. 1865, p. 228.
[5] CALDWELL'S Med. Theses, p. 81.
[6] Med. Museum, i. 433.
[7] Med. Histories, pp. 486 and 441.

feebleness of function arising from a scrofulous taint, and a morbid susceptibility to the influence of mercury. But in all of these respects, and in the two latter especially, iodide of potassium is of far greater efficacy.

Several cases of *diabetes mellitus* are reported as having been cured by this medicine, which also assuaged in a remarkable manner the characteristic thirst of the disease. In chronic derangement of the *liver* it was prescribed with advantage by Scott, who found it, however, less efficient than nitro-muriatic acid. A striking case of its efficacy is presented by Ffirth;[1] it was one of chronic enlargement of the liver in a scorbutic subject, and the disease was contracted in India. The medicine produced ptyalism, and from this event the patient's improvement commenced. Enlargement of the liver and spleen in the victims of scrofulous or syphilitic caries has been successfully treated by Dr. G. Budd with long courses of diluted nitric acid in the dose of fifteen minims three times a day.[2] Bateman employed it successfully in *jaundice*, and Zagli reported more than fifty cases of cure, which he attributed to its influence. "In those ill-conditioned *scrofulous sores* which approach the nature of cancer," says Chapman,[3] "it has proved the most successful of all the remedies which I have tried. Not a few of the cases which had previously resisted the best external modes of treatment, I have cured by the free internal use of it."

Rayer states that he cured very obstinate cases of *impetigo* by means of nitric acid, of which he gave half a drachm in a pint of sweetened barley-water in the course of the day. When it deranged the stomach its administration was suspended for a few days, and tepid baths were prescribed. It very rarely happened that a cure was not effected in from four to six weeks.

Externally.—This acid has been employed to *blister the skin* when the use of cantharides or other vesicants proper would have involved too long a delay. But it is far less to be recommended than ammonia, both on account of the severe pain it causes, and of the intractable ulcer that may result from its use. The *bites* of *rabid animals*, poisonous *serpents* and *insects*, etc., have also been cauterized with nitric acid. It forms an excellent ingredient for gargles and washes in secondary *syphilitic sores* of the throat or nasal passages, and when added to water so as slightly to acidulate it, is an efficient application for indolent as well as flabby or sloughing sores. Wedekind gave it internally to arrest *mercurial salivation*, but its local application by means of a mop, or, what is better, a fine brush, followed by the use of gargles containing about one drachm of the diluted acid to six ounces of water, usually succeeds in restoring a sound state of the mucous membrane of the gums. Thompson mentions having suspended mercurial salivation by its internal use. Lotions or foot-baths containing this acid have been found serviceable in *chilblains*, particularly after they have lost

[1] Med. Museum, ii. 62.
[2] Sydenham Soc. Year Book, 1863, p. 176, *d.*
[3] Therapeutics, ii. 519.

their acute character. Dewees recommended warm baths feebly acidulated with this liquid for the *jaundice* of new-born children.

By applying it over indolent *periostoses* so as to produce a slight inflammation of the skin, Lallemand found that it caused these swellings to disappear. The strong acid can be used as a caustic in most of the cases enumerated under the head of sulphuric acid, and particularly to remove venereal and other *warts* and fleshy excrescences of all kinds. In none is it more effectual than in curing *condylomata* and *hæmorrhoids*. It is applied by means of a mop of lint fastened upon a wooden handle, care being taken to avoid touching the surrounding skin, which, indeed, had better be smeared with resin cerate. The method undoubtedly is very painful, unless the patient's sensibility be first blunted by an anæsthetic internally or locally applied, particularly at the first application, but on the second it is less severe, and the acid is seldom required a third time.[1] In *caries* of the bones and in sloughing *phagedæna* the strong acid has often been employed successfully to promote the separation of the dead tissues. In *hospital gangrene* it is peculiarly serviceable.

Administration.—The dose of the stronger acid is from five to twenty minims, and of the diluted acid from twenty-five to fifty minims, three or four times a day, in at least three fluidounces of a watery vehicle. It should be taken through a tube. It should never be associated with salifiable bases, with the carbonates, acetates, etc., nor kept in metallic vessels.

CHLORINIUM.—Chlorine.

Aqua Chlorinii.—*Chlorine Water.*

Preparation.—*Chlorine water* is prepared by agitating chlorine gas with distilled water, which absorbs nearly twice its volume of the gas. To prevent its decomposition, it should be kept in glass-stoppered bottles, made impervious to light by a black coating. Chlorine was discovered by Scheele in 1774.

Action on Vegetables and Animals.—Chlorine destroys most vegetable colors if moisture be present. Nysten introduced a small quantity of chlorine into the jugular vein of a dog of medium size. The animal gave some signs of pain. After five minutes' interval, a larger portion was injected; the dog howled violently, breathed laboriously and painfully, and died in three minutes afterwards. The heart was found distended with fluid blood.[2] The same experimenter, on another occasion, introduced a quantity of this gas into the pleural cavity of a dog. The animal became very restless, voided urine, and then fell upon his side stiff, and without signs of pain. He arose afterwards, but continued to whine. For three

[1] W. Cooke, Times and Gaz., April, 1853, p. 343. H. Smith, Ibid., Aug. 1854, p. 184; Nov. 1855, pp. 526, 566; Lancet, Oct. 1858, p. 452.

[2] Wibmer, Wirkung, etc., ii. 107.

days he seemed to suffer greatly, and he was then killed. Both pleuræ were lined with false membrane, and contained bloody serum. Orfila found that, by introducing chlorine water into the stomach of dogs, inflammation and ulceration of the gastric mucous membrane were excited.[1] According to Nysten, pure chlorine gas, when breathed by animals, is not absorbed, but produces such rapid and violent inflammation of the bronchia as to prove fatal.

Wallace gives the following account of the effects of chlorine diluted with air and watery vapor upon the human skin.[2] When a person is inclosed, except the head, in a box, and subjected to this agent at a temperature of 110° F., in the course of ten or twelve minutes he experiences, in various parts of the skin, sensations like those produced by the stings or bites of very small insects. They gradually extend to the greater part of the body, but cease upon the patient quitting the bath, and are succeeded for a short time by heat and itching. A more or less copious sweat accompanies this sensation, and is followed by an eruption of minute pustules upon the trunk and arms. If chlorine is applied to a more limited surface, the skin grows red, and if the application is continued, it excites severe pain and swelling, which, as well as the redness, augments, so that the integument acquires an erysipelatous aspect, and, for some time afterwards, feels as if it had been bruised. These symptoms are of several days' duration, and are succeeded by itching and desquamation of the cuticle. That chlorine is absorbed by the skin is proved by the characteristic taste which is perceived in the mouth after the hand or any part of the cutaneous surface is exposed to its action. When inhaled in a concentrated form it acts as an irritant, exciting spasm of the glottis, and a sense of constriction of the chest and suffocation, or violent cough and hæmoptysis; but in a diluted state it produces a gentle sense of warmth in the air-passages, and increases the secretion of mucus. When habitually inhaled, it soon ceases to produce marked symptoms, and, indeed, is alleged to increase the appetite, but it occasions a loss of flesh. Yet it is said not to shorten the lives of the workmen engaged in factories where it is employed. These workmen are subject to acidity of the stomach, which they are in the habit of correcting by the use of chalk. The above statement regarding its influence on the appetite is confirmed by Hallé, who asserts that chlorine water, when largely diluted, augments the appetite and strengthens the digestion. Nysten alleges that it acts as an astringent on the bowels, producing constipation, and bleaching the excrements. A case of poisoning by chlorine gas, the only one on record, is reported by Dr. Cameron.[3] Sulphate of soda and chloride of lime in a moist state were brought together in the hold of a vessel which was loaded with them. Several sailors passed the night in the forecastle. In the morning one was dead and the others comatose. On examining the body of the former its cavities exhaled a smell of chlorine; the interior of the mouth was blanched

[1] Toxicologie, i. 113. [2] Ibid. [3] Dublin Quart. Journ., xlix. 116.

and the epithelium softened; the bronchia were full of frothy and bloody liquid, the lungs congested, the right side of the heart distended with blood, the left empty; the veins of the head were gorged with blood. Death appears, therefore, to have been due primarily to irritation of the respiratory passages, and secondarily to asphyxia. The lesions in this case seem to have been almost identical with those produced in dogs by the injection of chloric acid into the veins, as shown by Dr. Blake.[1]

Uses. *As a Disinfectant.*—Hallé was the first, in 1785, to point out the disinfecting properties of chlorine. A few years later (1791), Fourcroy proposed it as a means of neutralizing the effluvia arising from the decomposition of animal matter in graveyards, etc., and of destroying infectious miasmata. Chaussier employed it as a disinfectant in the dissecting-room, and Cruikshank first adopted it, on a large scale, as a means of purifying the air of hospital wards at Woolwich, in England. These examples did not, however, suffice to recommend the agent to general confidence until its properties were more fully illustrated by Guyton Morveau in 1803. About twelve years later, Thénard suggested the use of chlorine water instead of the gas, and it was employed to limit the ravages of an epidemic which then prevailed in Holland.[2]

Not a few examples might be adduced in which the use of chlorine appeared to arrest the extension of infectious diseases. The most striking illustrations, however, are furnished by diseases of a strictly local origin, those which appear to have arisen and to have been sustained by effluvia from accumulations of animal or vegetable matter in a state of putrefaction. But even here the alleged power of chlorine is open to question. That it destroyed the offensive odors of the decaying masses is certain; but when it is recollected that these collections were usually at the same time removed in whole or in part, and that the neighborhood was subjected to a more or less complete system of purification by means of water, air, heat, etc., the part of the result due to the action of chlorine was perhaps not very large. As regards epidemic diseases of atmospheric origin, such as cholera and yellow fever, it is certain that chlorine, in whatever manner employed, offers no obstacle to their diffusion. It is said that chlorine destroys the contagious property of the vaccine and the gonorrhœal virus,[3] but the statement needs confirmation. Chlorine water is a convenient agent for correcting the stench of alvine discharges in the sick room, the foul odor of the breath, of the offensive secretions of gangrenous and other sores, etc.

Fevers.—A great number of writers have testified to the virtues of chlorinated water and of the chlorides in different forms of fever, but especially in those of a typhoid or malignant type. It would seem to be indicated when the pulse is increased in frequency without being stronger than natural, or when there is an absolute loss

[1] Journ of Anat. and Phys., iv. 1.
[2] Mérat et De Lens, Dict. de Thérap., ii. 241.
[3] Clarus, Arzneimittel., p. 248.

of its force.[1] This is peculiarly the case in *petechial typhus*, during its middle stage; it is also a frequent incident of typhoid fever and the eruptive fevers, and is usually attended with a languid state of the capillary circulation, a dry, incrusted state of the mouth, fetid evacuations, and great debility. The effects of chlorine, here, are stated to be a reduction of the heat of skin and frequency of pulse, followed by perspiration, subsidence of the cerebral symptoms, diminished fetor of the breath and stools, and abatement of the tympanitis. The medicine was extensively used by military surgeons during the epidemics of typhus which ravaged the allied armies in the European campaigns of 1813–14, and many hospital physicians, attracted by its alleged success at this period, introduced it subsequently into civil practice. In certain cases, and in certain epidemics even, its effects appear to have been like those above described, but they were far from being generally so. In most instances it seemed to influence the course of the disease injuriously, if at all, and to augment the dryness of the tongue and skin. Hufeland, Marcus, Clemens, and others, found it useful as a means of appeasing the irregular tumult of the circulation, and promoting a crisis in *scarlatina;* and D'Alquen[2] went so far as to say that "it is here almost a specific like quinine in intermittent fever." This writer prescribed it especially in the anginose variety with copious eruption, burning skin, delirium, and convulsions. He appears, however, to have insisted very little on its internal administration. According to Noirot,[3] Braithwaite was the first to use chlorine (or as it was then called, oxygenated muriatic acid) internally, and held it to be as truly a specific for scarlatina, as mercury for syphilis or quinine for ague. "Used exclusively and systematically it has always been successful in my hands; my patients recovered promptly, and without secondary affections." The same historian informs us that Braun "held chlorinated water to be a sovereign remedy in malignant scarlatina. Turner regards it as a specific. Stanger, Hufeland, Durr, Kopp, Pfeufer, and Godelle, proclaim its virtues."

In 1829 Messrs. Taynton and Williams called attention to the efficacy of this medicine in the anginose and low types of the disease. In a brief note,[4] they "solemnly declare that it proved successful in almost every case in which they were called in time, and in which the medicine was faithfully administered." Dr. Tanner states that it "is used by some practitioners who speak highly of its good effects even in the worst cases."[5] In 1867 Dr. Charles C. Lee published some striking examples of its success during an epidemic of scarlatina in the Philadelphia Hospital, and subsequently, when it appeared to be much more efficient than other remedies.[6] Dr. Matthew Gairdner applied it with marked advantage to the treatment of the closely allied disease, *diphtheria*, during

[1] Sachs und Dulk, Handwört., ii. p. 195.
[2] Lancet, Jan. 1841, p. 617.
[3] Hist. de la Scarlatine, p. 356.
[4] Lond. Med. Gaz., Sept. 1829, p. 432.
[5] Diseases of Infancy, etc.
[6] New York Med. Journ., v. 482.

a severe epidemic of that affection. He recommended chlorine water prepared as follows: "Put eight grains of chlorate of potassa in a strong pint bottle, and add a drachm of strong hydrochloric acid; close the mouth of the bottle whilst the violent agitation lasts, then add water, ounce by ounce, with constant agitation until the bottle is full. An adult may use the whole pint in a day."[1] The officinal chlorine water, diluted so as to be swallowed without serious repugnance, would probably be quite as efficacious.

A similar method was employed in Germany by Dyes, who claims that its timely use is always followed by cure, and is never followed by paralysis; and that it is a prophylactic also for those who are exposed to the contagion of the disease. The same physician recommends the atomized liquid in cases of laryngeal diphtheria.[2]

As a *lotion* during the hot stage of *typhus*, and indeed of other fevers, it has been thought to be effectual in giving softness to the integument and lowering its temperature. D'Alquen alleges it to be peculiarly useful in *scarlatina*. He directed the skin to be washed with a sponge saturated with equal parts of lukewarm water and chlorinated water every two or three hours until the approach of the crisis. If it produces chilliness, the application should be suspended. The crisis, as described by this writer, is denoted by a violent degree of fever and delirium, and even convulsions, which symptoms last for two or three hours, and are succeeded by a rapid declension of the fever, etc. This sketch is hardly drawn from nature, and were it even so, the decline of the febrile symptoms cannot be attributed to the chlorine employed so much as to the sponging with water, for this alone, as every physician knows, will sometimes bring about a resolution of the fever, and that without the intervention of any such "crisis" as is here attributed to the action of chlorine. Chlorinated water has been highly recommended as a lotion in *smallpox*, during the maturative and subsequent stages. A weak solution, at a proper temperature, is perhaps useful as a means of correcting the fetid exhalations of the skin.

Diseases of the Lungs.—It was imagined at one time that in chlorine would be found a specific for *pulmonary consumption*. Workmen disposed to the disease were thought to be benefited by the exhalations in factories where chlorine was employed. Patients affected with phthisis were lodged in apartments where, at regular intervals, or constantly in some cases, this gas was allowed to mingle with the atmosphere. In one of the reports made of the results of this treatment it was said "that all of the patients were relieved, and experienced a remarkable degree of comfort; the breathing became freer, the sputa scantier, and there was neither a sense of heat in the chest, fever, nor hæmoptysis, and some of the cases got well."[3] These striking results were published by M. Gannal, and were more or less confirmed by other physicians at the time; but

[1] Edinb. Med. Journ., xvii. 513. [2] Prager Vierteljarschrift, xciv. Anal. 8.
[3] Mérat et De Lens, Dict. de Thérap., ii. 247.

the method speedily lost the degree of confidence it had acquired, and fell into complete disuse. In a memoir presented to the Royal Academy of Medicine[1] by M. Jolly, the author states, as his conclusion from sufficient experience, that the use of chlorine inhalations, or of an atmosphere of the gas, is wholly useless in consumption of the lungs, and that in many cases it even acted mischievously by increasing the cough, the oppression, and the fever. The remedy is nevertheless claimed to be endowed with some power of palliating the cough and moderating the expectoration in certain chronic diseases of the lungs. Pereira, indeed, declares his belief, with Albers, that in ulceration of the lungs it occasionally may be of essential service. But what ulceration is meant, if not "tubercular," does not appear. *Chronic catarrh* seems to have been favorably modified by chlorine inhalations, but as remedies for this disease they seem to be in every respect inferior to terebinthinate medicines. *Whooping-cough* has in some cases been palliated by the same means. In all of these pulmonary diseases chlorine and its preparations exert no curative power, and they are indeed seldom used in their treatment, except to correct the fœtor of the breath in certain bronchial affections.

Gaseous chlorine, either pure or mixed with air, in the form of a bath, was recommended by Wallace, Zeise, Julius, and other writers, for the cure of *jaundice*, *biliary calculi*, and *dropsies*, dependent upon functional disorder of the liver. The first mentioned writer, however, employed the vapor at a temperature of 150° F., and this fact, which seems to have been overlooked in estimating the value of his plan of treatment, is a sufficient explanation of its effects, without attributing much if any part of them to the chlorine itself.

Chlorinated water and chlorinated oil have been thought useful in some *scaly eruptions* of the skin and in *scabies*. The former has also been recommended for the cure of *chilblains*. This preparation has also the valuable property of destroying the *fetid smell* of cancerous and other sores, and otherwise improving their condition. In *putrid sore throat* it is a very useful ingredient of washes and gargles. Fumigations of chlorine are sometimes used in hospital wards and the chambers of the sick when the air becomes offensive by the patients' exhalations or discharges.

Animal Poisons.—Chlorinated water has at different times been vaunted as a preventive of the infection of *syphilis*, of *rabies canina*, of the *plague*, of the poison of *venomous insects*, etc. As a protection against hydrophobia it seems to occupy similar ground with many vaunted but now neglected specifics. Many persons, it is true, who had been bitten by rabid animals, escaped madness after their wounds were washed with chlorinated water, or some other preparation of chlorine. But this fact is stripped of all its value when it is considered that the same result frequently takes place when no treatment whatever is applied to the bitten parts; that, in fact, the teeth of the animal have been wiped of their poisonous slaver by

[1] Bull. de l'Acad., iii. 272.

penetrating the clothing of the person attacked. It is, however, alleged that chlorinated water, given internally, has actually cured fully-developed hydrophobia. But the cases upon which the assertion is founded are too few and too obscure to shake conclusions which rest upon the basis of a large mass of well-authenticated facts. In regard to the power of this agent to prevent *syphilitic contagion* very similar objections may be made. Impure coition by no means necessarily communicates the disease, and there is therefore no more reason to believe that chlorine more than simple water can avert its consequences. The same remark may be made respecting the ability of chlorine to destroy the supposed contagion of the *plague* in clothing and other fomites. Its power seems to be neither greater nor less than that of the ordinary means of purifying infected articles.

Administration and Dose.—The dose of chlorine water is variously stated by different authors to be from *one* to *four fluidrachms* properly diluted. It may be given with four, five, or six parts of distilled water, sweetened. It is decomposed by all decoctions and infusions, except decoction of jalap (D'Alquen). For inhalation from *ten* to *thirty* drops of chlorine water should be mixed with six or eight ounces of water, and inhaled from a proper apparatus several times a day.

Antidotes.—Albumen is the best antidote to poisoning by chlorine. That substance may be given in the form of milk, the white of egg, veal broth, etc., and should be taken in large quantities, so as to encourage vomiting. In the absence of albuminous articles, flour, or even the alkaline earths, may be tried. Inflammation of the stomach is to be combated with emollients.

LIQUOR SODÆ CHLORINATÆ.—Solution of Chlorinated Soda.

Preparation.—Solution of chlorinated soda is obtained by decomposing a solution of carbonate of sodium by one of chlorinated lime. A reciprocal interchange of elements takes place, and, carbonate of lime being thrown down, chlorinated soda remains in solution. It is a colorless, transparent liquid, possessing an alkaline reaction, a taste at once alkaline and saline, and a slight odor of chlorine. It destroys the color of vegetable substance; by exposure to the air it gives off chlorine, and is rapidly converted into carbonate of sodium.

History.—In 1826, M. Labarraque published his formulæ for preparing the chlorides, and soon afterwards introduced chlorinated soda into medical practice. It has hence been generally known as *Labarraque's liquid* or (from the purposes for which it was applied) *disinfecting agent.*

Action. *On Animals.*—The washing liquid used in France under the name of Eau de Javelle, is a chloride of potassium. Accord-

ing to Ségalas,[1] concentrated chlorinated soda is irritating and caustic, and, if absorbed, manifestly alters the blood. This author and Christison both state that it gives rise to tetanic spasms. When administered to dogs by Orfila, it produced violent attempts to vomit, and copious liquid stools, followed by agitation, and then by exhaustion and death. The stomach and intestines of the animals were found to be inflamed.[2]

On Man.—Mérat and De Lens saw a girl of sixteen who had drunk a glass of the washing liquid. The chief symptom was general rigidity, which yielded, however, to demulcent drinks. The symptoms of a case of poisoning by this preparation are related by Dévergie, but they seem to have been caused in part by strong mental disturbance. They were as follows: Convulsions, loss of consciousness, extreme pain in the pharynx and œsophagus, with difficult deglutition, tenderness of the epigastrium, but neither vomiting nor diarrhœa. Other cases, reported by Orfila and by Taylor, presented essentially the same phenomena. Gendrin saw hæmorrhoids produced in a person who was taking this medicine for the relief of goitre. It is said to promote menstruation. A dessert-spoonful of solution of chlorinated soda was given by mistake to an infant of one year old. It was scarcely swallowed before the exhaled chlorine produced signs of suffocation. The fauces were speedily cleansed, but the child cried and moaned with a hoarse voice, rolled about incessantly, and coughed violently. The skin grew pale and damp, the pulse was small and scarcely perceptible, the abdomen indolent, the buccal mucous membrane was whitish, and the breath smelled of chlorine. Subsequently the abdomen became tender upon pressure, and a copious watery discharge, which smelled of chlorine, took place from the bowels.[3]

"In moderate or small doses," says Pereira, "chloride of soda has been denominated stimulant, tonic, astringent, antiseptic, and febrifuge." But, as he justly observes, these terms give no real explanation of the nature of those organic changes whereby we obtain such benefit from the employment of the medicine in various diseases. He states that he has seen moisture of the skin follow its use in fever; that increased secretion of urine is a common effect of it; that in fevers it improves the qualities of the evacuations; and that it causes chronic glandular enlargements and chronic mucous discharges to disappear. Perhaps this author, and several others who make the same suggestion, are right in attributing these effects to the soda rather than to the chlorine which the compound contains.

The *antiseptic* qualities of chlorinated soda, depending as they do upon the chlorine which it contains, are closely analogous to those of chlorinated water, and of chloride of lime, under which heads this branch of the subject will be found more fully treated.

[1] Mérat and De Lens, Dict. de Thérap., ii. 256.
[2] Toxicologie, i. 294.
[3] Dierbach, Neuste Entdeck., iii. 914.

Remedial Uses. *Typhoid Fever.*—Chlorinated soda was at one time very much used in the treatment of typhoid fever, both internally and externally, in lotions and in baths. Chomel[1] subjected this method to a very careful and thorough trial. It was supposed at first to exercise a salutary influence, but was soon discovered to deserve no higher confidence than other reputed specifics for the disease, and it was therefore abandoned altogether.

Foul Ulcers.—A great many writers have recommended the solution of chlorinated soda as a wash for unhealthy ulcers, particularly those of an irregular surface, with sanious secretion, and also for ulcers attacked with gangrene. Ulcers of the gums and of other soft parts within the mouth and fauces are very apt to assume these characters in scarlatina and diphtheria, and in persons of a cachectic constitution, particularly in consequence of mercurial salivation or of syphilis. In fact, whenever a gangrenous tendency betrays itself, the chloride of soda is useful as well for correcting the offensive odor, which it does most effectually, as for stimulating the sound tissues to throw off the dead portions. The strength of the solution must, however, be carefully adjusted to the sensibility of the part. In chronic inflammation of the mucous membrane of the ears, mouth, urethra, vulva, uterus, etc., with a sanious fœtid or otherwise unhealthy discharge, a weak solution of this preparation is often of great utility.[2] Mixed with honey and water, it forms a valuable wash for aphthæ of the mouth. In certain acute inflammations attended with an acrid secretion, such as that of the fauces and nasal passages in anginose and in malignant scarlatina, injections of this fluid are of material advantage in preventing local ulceration and the diarrhœa to which the foul matter is apt to give rise when it is swallowed.

Ulcers.—As an application to ulcers, this liquid was much praised by Lisfranc.[3] He held it to be resolutive, sedative, and healing in its influence. He rejected its use when the affected part was indolent, upon the ground that it then hindered the vital processes essential to cicatrization; he objected to it equally when the local inflammation was excessive, because it augmented this process. The appropriate period for its use, according to him, is when granulations are well developed and a cicatrix begins to form. In *burns* of the first and second degree, Lisfranc prescribed chlorinated soda for the sake of its resolvent and sedative action, and in those of a severer grade he taught that it allays inflammation at first, and subsequently favors the separation of sloughs and promotes healing. These explanations, it will be perceived, do not perfectly harmonize with one another. It would seem that the principles upon which the solution ought to be applied are not well settled. The mode of application recommended by Lisfranc is the following. The affected part is, first, to be covered with a cribriform compress spread with

[1] Compend. de Méd. Prat., viii. 258.
[2] Guibourt, Bull. de l'Acad., iii. 273.
[3] Bull. de Thérap., xv. 39, and xvi. 252.

cerate, over which a thick pledget of lint soaked in chlorinated soda is applied. The solution ought to be strong enough to excite a moderate degree of heat and itching, and should be frequently renewed. Any phlyctenæ that exist upon the skin should first be punctured. Although this method of treatment has distinguished recommendations in its favor, and is certainly not wanting in usefulness, its advocates seem to have attributed results to the chlorine in the solution employed which were certainly quite as justly due to the associated alkali or even to the water of the dressing alone. Among the simple ulcers which chlorinated soda seems especially fitted to cure *sore nipples* may be mentioned.

Godier asserted the usefulness of chlorinated soda in *scrofula*, both when taken internally and when applied in a salve to enlarged glands. It has also been used in a great variety of *skin diseases*, and with less reference, it would seem, to their systematic form than to the vital state of the skin. When the eruption remains stationary or tends to grow worse, owing to debility of the skin itself, the stimulant agency of this preparation of soda has been found useful, but less so, it is believed, than those of the carbonate. In *smallpox*, Eisenmann recommended lotions with chlorinated water. He averred that they rendered the eruption milder, yet favored its development, and at the same time prevented the formation of hard scabs and cicatrices.[1]

In *poisoning* by sulphuretted hydrogen, this liquid may be used advantageously as an antidote, but it is less appropriate than chlorinated lime.

Administration and Dose.—"The dose of the officinal solution of chlorinated soda is from thirty drops to a teaspoonful, given in a cupful of water or mild aqueous liquid, and repeated every two or three hours." When used as a *gargle*, it should be diluted with eight or ten parts of water. As an *injection* into the vagina, uterus, or bladder, and as a *lotion* for burns, excoriations, and cutaneous eruptions, a solution in eight or ten parts of water is appropriate. A stronger solution may be directed in the treatment of gangrenous sores. Pereira states that in some sloughing ulcers he has used the officinal liquid mixture with its own volume of water, but that when first applied it should be much more largely diluted, as with five or six parts of water.

CALX CHLORINATA.—Chlorinated Lime.

Calcii Chloridum.—*Chloride of Calcium.*

Liquor Calcii Chloridi.—*Solution of Chloride of Calcium.*

Description.—*Chlorinated lime* is a compound resulting from the action of chlorine on hydrate of calcium, and contains at least

[1] See also Gabb, Am. Journ. of Med. Sci., July, 1857, p. 232.

twenty-five per cent. of chlorine. It is a grayish-white substance, in lumps or powder, slightly moist, with an acrid, bitter, and astringent taste, and the odor of chlorine. *Chloride of Calcium* is prepared by fusing chalk saturated with muriatic acid. It is colorless, translucent, hard, and friable, has an acrid, bitter, saline taste, is very deliquescent, and soluble in rectified spirit. It exhales no odor of chlorine. *Solution of chloride of calcium* is prepared by acting on marble with muriatic acid and water, evaporating to dryness, dissolving the residue in water, and filtering.

Chlorinated lime is chemically incompatible with the mineral acids, with carbonic acid, and with the alkaline carbonates. Gibourt[1] found that when equal quantities of powdered sugar and chlorinated lime are triturated together, and then inclosed in a well-stoppered bottle, along with a small proportion of water, caloric is rapidly disengaged, and in a few minutes the mixture explodes. This mixture possesses no decolorizing properties, and is decidedly acid in its reaction. Hunoux Desfontenelles observed that in preparing pills of chlorinated lime with extract of opium and honey, the compound took fire spontaneously, and was consumed. A similar reaction obtains between this substance and liquorice, and also althea root. It is said to neutralize the narcotic principle of opium.[2]

History.—Chlorinated lime was first described in France, by Décroizelles,[3] but it only became known through Mr. Tennant, of Glasgow, who, in 1798, took out a patent for its manufacture as a bleaching powder. In 1803, Guyton Morveau drew attention to it as a prophylactic against contagion, and Dupuytren and Barruel afterwards employed it to disinfect a privy-well, which contained hydro-sulphide of ammonium. In 1811, Masuyer, of Strasburg, published the results of his experiments with it for purifying hospital wards, dissecting-rooms, etc.; but it was not until the appearance of Labarraque's essay, in 1822, on the disinfectant properties of the chlorides, that this preparation was extensively employed as a medicine.

Action.—The *modus operandi* of chlorinated lime upon the animal economy is not settled. It resembles, however, that of chlorine, with a superadded causticity derived from the lime in its composition. In moderate doses it sometimes appears to act as an irritant of the stomach and bowels; and if the quantity taken be large, it produces heat in the epigastrium, nausea, vomiting, and diarrhœa. Jolly observed[4] that the chloride of lime, as well as of soda, when used as a gargle or mouth-wash, removes acid, bitter, saline, or metallic tastes from the mouth, and that for several days together.

Externally its operation is that of an active irritant, and sometimes it is even moderately caustic. When applied to suppurating surfaces it is a powerful desiccant, owing, probably, as Pereira sug-

[1] Bull. de l'Acad , ii. 976.
[2] Strumpf, op. cit., ii. 617.
[3] Mérat and De Lens, op. cit.
[4] Bull. de l'Acad , iii. 277.

gests, to the uncombined lime in its composition. Its peculiar advantage is shown in its preventing or suspending gangrenous ulceration. Heiberg observed that, like other stimulants, it acted as an irritant or as a wholesome tonic, according to the strength of the solution of it employed.

Chloride of calcium is an active irritant, and if taken in excessive doses may occasion the gastro-intestinal symptoms of irritant poisons.

Remedial Employment. *Fever.*—Reid and others used chlorinated lime in the epidemic typhus of Ireland, and ascribed to it the faculty of rendering the tongue moist and clean, appeasing the delirium, and reviving the cutaneous functions. Graafe prescribed it dissolved in an infusion of valerian,[1] with apparent advantage in typhoid fever. Edwards regarded it as improving the secretions and sustaining the strength in this disease.[2] It was extensively employed for its therapeutical effects, as well as for its disinfectant qualities, in the oriental plague. Grimod alleged that, in an epidemic of *smallpox*, children were preserved from the contagion by being washed with a weak solution of this compound. Gubian, of Lyons, also employed it to prevent pitting after variola. But neither of these methods has stood the test of experience.

Inflammation.—Guthrie and others made use of a solution of chlorinated lime, with excellent results, in purulent ophthalmia, by dropping it into the eye, or applying it by means of a camel's hair pencil. The strength of the solution varied from one scruple to several drachms in an ounce of water.[3] But these authorities do not appear to have omitted any of the ordinary sedative, revulsive, or depletory measures which are usually relied on for curing the disease. Varlez also employed it in the purulent ophthalmia both of adults and of infants. For the latter a solution of ten grains to the ounce was used. By its means, he asserts[4] that he succeeded, after all other means had failed, in arresting an epidemic of purulent ophthalmia, which was ravaging the French army in the Netherlands. He instilled the freshly-made collyrium between the lids of the affected eyes, from three to ten times every day. Hasse, of Dresden, made use of it as a prophylactic against the disease in the infants' hopital of that city, as well as for curing the affection in them and in adults.[5] Deconde, a Belgian military surgeon, testifies to the same effect,[6] and Pereira found it a successful application. Eberle employed it in several cases with great advantage.[7] Ricord ascribed the speedy cure of a case of *frostbite* of the fingers to the use of a dressing of charpie saturated with a solution of chlorinated lime;[8] and Lisfranc and Graafe employed it successfully for the same affection.[9] The last-named writer, Caussade,[10] and Roussif used it both internally and as an injection for the cure of *gonorrhœa*,

[1] Giacomini, Mat. Med., 469.
[2] Strumpf, loc. sup. cit.
[3] Richter, op. cit., iv. 313.
[4] Mérat and De Lens, Dict. cit.
[5] Dierbach, Neuste Entdeck., i. 416.
[6] Ibid., iii. 903.
[7] Therapeutics, p. 289.
[8] Richter, op. cit., iv. 312.
[9] Dierbach, i. 414.
[10] Ibid., p. 418.

and, as they report, successfully; but the method does not seem to have been frequently adopted. It is said at first to increase the flow of urine and to produce some irritation of the urethra, but these symptoms, and the discharge with them, soon decline. In *hospital gangrene* this remedy is very effectual, at least in the milder cases. Sanson made use of it in *ulceration* of the *mouth*, with caries of the hard palate; Lagneau in *softening* and gangrene of the *gums;* Kopp, of Hanau, in *scorbutic* gangrene of the mouth; Angelot, of Besançon, Delpech, Percy, Travers, Roche, Cloquet, and many others, might be cited to the same effect. Jolly states[1] that he used the dry chloride of lime with marked success for ulceration of the gums and gangrenous pustule (ulcus noma) in children, and Berndt also employed it with great advantage in the same affection. The solution of chlorinated lime forms a very excellent wash for the Schneiderian membrane when it becomes inflamed and ulcerated in scarlatina, and also in chronic inflammation of this tissue. *Indolent ulcers* were successfully treated by Lisfranc with this solution, which was applied to them in the manner already described for chloride of soda. It is stated to have induced the healing of ulcers which had resisted other modes of treatment for eight or ten months. In a case of fistulous ulcer, Ricord effected a cure by its means. Heiberg extolled its virtues in cases like those mentioned, and also in *burns* and in *syphylitic* and *cancerous* sores. He regarded it as possessing a decidedly anodyne quality, especially in open cancer.

Diseases of the Skin.—Preparations containing chlorinated lime have been largely used in numerous cutaneous diseases. Kopp recommended them in scaly as well as vesicular eruptions,[2] and Wenzel reported a very high degree of success in the treatment of *tinea capitis* (? *favus*) by means of an ointment made with this compound. But in the Berlin Hospital it was found, after a four years' trial, that a solution of chlorinated lime was incompetent to cure the disease. It cleansed the head and moderated the inflammation of the scalp, but did not reach the alteration of the hair bulbs, which properly constitutes the malady. Numerous writers have testified to its efficacy in the treatment of *itch.* For this purpose Kopp applied a solution of from one to three ounces in a pint of water three or four times a day. Fontanelli made extensive use of it in public and private practice. He precribed a general warm bath every third day, and usually completed the cure within a week. Michælsen[3] obtained similar effects from the remedy, and gave the preference to it over sulphur because it is less offensive. Derheim alleged that he cured the itch in from six to ten days, by means of a lotion of chlorinated lime.[4] Schönlein and Hôpital employed a liniment composed of chlorinated lime and black soap, and state that it was successful in the most inveterate cases of the disease. Christison says that he used this remedy with the best effects, and

[1] Bull. de l'Acad. de Méd., iii. 274.
[2] Richter, op. cit., iv. 308.
[3] Dierbach, op. cit., iii. 905.
[4] Mérat and De Lens, Dict. cit.

that since he first employed it he never had occasion to use any other. He directed a solution, containing between a fortieth and a sixtieth of the chloride, to be applied five or six times a day, or continuously, with wet cloths, and found that it allayed the itching in the course of twenty-four hours, and generally accomplished a cure in eight days.[1]

It is not, however, to be concealed that other physicians have not only found the remedy objectionable on account of its irritative action, but some even, like Ebermaier,[2] deny that it is curative at all. The truth appears to be that it is an effectual, but not always an eligible, remedy. It speedily irritates the delicate skin of females, and produces erosions, or else a vesicular or pustular eruption. It is more advantageous when the derm is dense and hard.

Diseases of the Lungs.—Evidence might be found in medical records of the use of chlorinated lime in *phthisis;* but after an examination of the data, it seems perfectly evident that the medicine has no other influence on this disease than to control, to some extent, the pulmonary secretions. In *chronic bronchitis*, with copious purulent expectoration of a fetid character, it has certainly been serviceable. In a case of thoracic fistula, communicating with the lung and discharging offensive pus, Eisenmann administered the remedy internally and injected also a weak solution of it into the fistulous opening. It corrected the fetor of the breath, gradually diminished the discharge, and ultimately contributed to a perfect cure.[3] In a case of acute inflammation of the lung, attended with fetid breath and sputa, hectic fever, etc., Drs. Graves and Stokes administered chloride of lime associated with opium. A very rapid amendment followed, and the fetor of the expectoration disappeared in the course of a few days. When the medicine was suspended, the discharge became again offensive, and was again corrected by a return to the use of the remedy.[4] Dr. Popham also treated a similar case successfully with this medicine and general stimulants.[5]

Scrofula.—Cima employed chlorinated lime successfully in scrofulous swelling of the *glands.* He directed from one scruple to one scruple and a half of it to be dissolved in six ounces of distilled aromatic water, of which a tablespoonful was given every two or three hours. It occasioned slight colicky pains, warmth in the stomach, and sometimes diarrhœa. After the use of the remedy for several months, the indurated glands became smaller, and the functions of the lymphatic system were re-established. He also prescribed an ointment composed of from one to three scruples of the chloride to an ounce of butter, with remarkable success, for scrofulous tumors of the cervical and inguinal glands, and of the hands and feet, which had resisted mercurial frictions. The tumors at first became red, then itched severely, and at last grew softer

[1] Dispensatory (Am ed.), p. 302.
[2] DIERBACH, op. cit., iii. 906.
[3] Ibid., 908.
[4] Am. Journ. of the Med. Sci., viii. 239.
[5] BELL'S Bull. of Med. Sci., i. 374.

and smaller.[1] Similar effects are ascribed to the internal use of a solution of chloride of calcium, especially in *tabes mesenterica.*

As a Disinfectant.—About the year 1825, Labarraque, Hayen, Chevallier, Gay Lussac, and many others, drew general attention to the power of chlorine to prevent or suspend the decomposition of animal matter, and to neutralize the offensive or pernicious odors resulting from this process. The way in which chlorinated lime acts is, according to Dr. Bache, exclusively by its chlorine,[2] which, being loosely combined, is disengaged by the slightest affinities. All acids, says this writer, even the carbonic, will liberate it, and as this acid is a product of animal and vegetable decomposition, noxious effluvia furnish the means, to a certain extent, of their own disinfection by the chloride. It was early employed for the preservation of bodies, in judicial investigations, by wrapping them in cloths wet with a solution of the compound, as well as for neutralizing the odor of decomposition after this process had commenced. Subsequently it was used to disinfect workshops, ships in which disease had prevailed, prisons, lazarettoes, hospitals, dissecting-rooms, theatres, sick-chambers, fomites of all kinds, markets, slaughter-houses, mines, privies, water-closets, sewers, wells, cesspools, stables, sties, and, in a word, all places rendered offensive and unwholesome by the putrefaction of animal or vegetable matter. Its faculty of neutralizing foul smells led to a belief that it was capable of counteracting diseases which the sources of such smells appeared to generate. The plague, cholera, yellow fever, smallpox, and other diseases which occur more or less epidemically, were made the subjects of numerous experiments, and the opinion was at one time entertained that fomites supposed to be vehicles for such diseases are purged of their infection by being subjected to the action of chlorine, and especially of chlorinated lime.[3] It was very common for persons living within the limits of an epidemic to carry little bags containing this substance, which they snuffed from time to time, to neutralize the poison they might have inspired. Articles of furniture, and whatever served for communication among men, ordinary food, even the healthy body itself, were deemed impure until duly washed or otherwise imbued with this preparation. In cities ravaged by the pestilence, persons were to be found who remained constantly in the same apartment, timidly breathing the exhalations of a vessel of chlorinated lime in preference to the pure and open air. It is related that, during an epidemic of cholera in

[1] Richter, op. cit., iv. 305 and 311.

[2] U. S. Dispensatory.

[3] It is far from being demonstrated that any of these diseases, except smallpox, can be communicated by so indirect a channel. It cannot be denied that many who wore the clothing of the victims of pestilential disease, did themselves contract it, but it is not certain that the infection was communicated by means of these fomites. When, therefore, the latter, after having been subjected to the action of chlorine, failed to impart the disease, the disinfecting power of the agent was by no means proved. Had it been shown that certain articles of clothing had really, in the first instance, been sources of infection, and that after having been subjected to the action of chlorine they lost their infectious quality, the disinfecting power of chlorine would have been at least probable; but in the absence of such a test, it may reasonably be questioned.

Moscow, the disease destroyed many of these very persons who had resolved to draw no breath that was not impregnated with the fumes of chlorine.[1] The uselessness of this agent as a prophylactic was attested by thousands of witnesses, many of whom did not hesitate to affirm that it increased rather than diminished the dangers of infection. Nor were other precautions a whit more effectual unless accompanied by attention to personal and domestic cleanliness, prudence in diet and exercise, and a cheerful disposition. The addition of chloride of lime to the number of these prophylactics became almost a matter of indifference.

In many diseases attended with *offensive effluvia*, chloride of lime is extremely useful both for correcting this symptom and for improving the condition of parts which give rise to it. A solution of the compound was found by Deslandes of great utility in a case of *retained placenta* which became putrid in the uterus. It was applied by injection, and appeared to suspend the disorganizing process as well as to correct the stench of the discharges. A solution of an ounce of the chloride in a pint of water was directed. Labarraque injected a solution of it into the vagina and uterus, to neutralize the fetid discharge in *cancer* of these organs; in gangrene of the lungs it has been used to counteract the like symptom as well as to arrest the disorganizing process.[2] The late Prof. Horner treated successfully an aggravated case of *ozæna* by its means, and reported several others as in process of cure under its use.[3] The late Dr. Awl, of Ohio, furnished an interesting example of the same result,[4] and Koechling another in which the disease supervened on suppression of transpiration from the feet.[5] It may be applied with advantage to correct *foul breath* produced by the caseous secretion of the mucous crypts of the fauces, by decayed food between the teeth, or by the use of tobacco. It is also useful in correcting the *acrid secretion* of the salivary and mucous glands of the mouth, in moderating mercurial *salivation* and correcting its fetor, as well as in healing the ulcers which attend it, in preventing the formation of *tartar* upon the teeth, and in arresting the progress of *caries* in them, while it does no injury to the enamel. It is also a useful palliative for the offensive odor which the *feet* and other parts of certain persons exhale.

Poisoning by Sulphuretted Hydrogen, etc.—Chloride of lime decomposes hydrosulphuric acid, hydrosulphuret of ammonia, sulphuret of potassium, and hydrocyanic acid, and may therefore be used as an antidote for these poisons. Labarraque restored a person who had been rendered insensible by the effluvia of a privy which he was engaged in cleansing, by holding a cloth wet with a solution of chloride of lime before his mouth and nostrils. Vinegar, ether, etc., had already been used without effect.[6] It was by breathing air impregnated with the gas arising from chlorinated lime, that

[1] Richter, op. cit., suppl. Bd., p. 529.
[2] Ibid., op. cit., iv. 312.
[3] Am. Journ. of Med. Sci., vi. 265.
[4] Ibid., xi. 543.
[5] Strumpf, Handbuch, ii. 626.
[6] Richter, op. cit., iv. 308.

Mr. Roberts was enabled to traverse with safety the sewer of the Bastille, which had not been cleansed for thirty-seven years, and which was impregnated with hydrosulphuric acid. If a person be required to enter a place suspected of containing this gas, a handkerchief moistened with a solution of chlorinated lime should be applied to the mouth and nostrils, so that the inspired air may be purified before it passes into the lungs.[1]

Administration and Dose.—The dose of chloride of lime is from one to five or six grains in solution. From ten to sixty grains may be administered in the twenty-four hours, dissolved in from four to eight ounces of water and then decanted and filtered. If the statements of M. Jolly, above quoted, are correct, chloride of lime should not enter into mixtures that contain sugar, lest a disengagement of the chlorine take place. As a wash for the mouth and other cavities lined by a mucous membrane, Christison recommends one part of the chloride to one hundred of water. For *external* use, the most energetic form in which the remedy can be applied, is that of a semi-fluid paste; the feeblest, to have any effect at all, is in the proportion of one drachm of the chloride to eight ounces of water. From 60 to 240 grains in a pint of water forms a solution of medium strength. As an application to dry atonic ulcers, an *ointment*, composed of equal proportions of chlorinated lime and lard may be employed; but for less indolent parts, such as scrofulous glands, the proportion of 60 grains to the ounce is more eligible. The dose of solution of chloride of calcium is stated to be *thirty minims*. It may be gradually increased to a fluidrachm or more, and should be given in milk or sweetened water.

ACIDUM MURIATICUM.—Muriatic Acid.

Natural Sources.—Muriatic or hydrochloric acid is found in the springs and streams of certain volcanic regions. According to Chevreuil, it exists in the sap of Isatis Tinctoria. It occurs in the mineral kingdom abundantly in combination with alkalies, earths, and metals, but most of all in muriate of soda (chloride of sodium), or common salt. In the animal kingdom it is believed to form a principal constituent of the gastric juice, and thereby to act as the chief solvent of fibrin, albumen, etc.

Preparation and Properties.—It is obtained by the reaction of sulphuric acid with common salt. The products of this reaction are sulphate of soda and muriatic acid. The latter, as thus obtained, is a gaseous body which, by union with water, forms liquid muriatic acid. It is colorless and transparent when pure, but, as found in commerce, has a yellowish or even a brownish tint. Its smell is acid, and its taste intensely sour and burning. When exposed to the air, it gives off dense white fumes. The sp. gr. of the medicinal acid is 1.16. *Diluted Muriatic Acid* (Acidum Muriati-

[1] Pereira, Mat. Med., i. 582.

CUM DILUTUM) consists of one part of the stronger acid to two parts by measure of distilled water. Its sp. gr. is 1.038.

History.—According to a quotation in Pereira's *Materia Medica*, muriatic acid was probably known to Geber, the Arabian chemist, in the eighth century. Basil Valentine discovered it in the fifteenth century. Priestley, in 1774, obtained gaseous muriatic acid, the composition of which was first determined by Scheele.

Action. *On Animals.*—When injected into a vein it coagulates the blood, but not so strongly as sulphuric acid, nor does it, when absorbed from the stomach, have so decided an action upon this fluid. The general symptoms produced by it are nearly identical with those of nitric acid.

On Man.—In small doses, medicinal muriatic acid occasions an agreeable warmth in the stomach, and generally some quickening of the pulse, cheerfulness, flushing of the face, and an increased flow of urine. Its protracted use sometimes causes salivation. In larger doses it excites the brain in a peculiar manner, causing giddiness, confusion of the senses, a sort of intoxication, in fine. In a diluted form it agrees better with the digestive organs than either sulphuric or nitric acid. This circumstance is explained chemically by the fact that it is more readily neutralized than the latter by the organic substances which it meets with in the stomach. It has a feebler caustic action than the acids mentioned. In a concentrated form, however, it combines with the albumen and the organized tissues of the stomach, acting as a caustic, attacking and corroding the coats of the organ. The symptoms it occasions resemble, in their kind, but are less in degree than those of the other mineral acids. Around the mouth and on the lips is a brownish-yellow stain, or a superficial slough; the tongue is dry and brown, the mucous lining membrane of the mouth excoriated, and more or less covered with a brown or yellowish crust. Soreness and burning of the fauces, dysphagia, and pain in the epigastrium are complained of; a fetid odor exhales with the breath; there is vomiting, and the stools are apt to be dark and bloody. After death, besides the lesions of the face and mouth, the following have been observed: capillary injection of the surface of the heart whose right cavities generally contain clots or liquid blood, while the left are empty. The lungs may be pale and bloodless, or, on the other hand, hepatized; the larynx is usually injected, the trachea less so, if at all; the bronchia contain frothy mucus. The mucous membrane of the pharynx is injected, corrugated, and softened; that of the œsophagus in like condition; the gastric mucous membrane is red or brown, pulpy or sloughy, and the entire thickness of the coats is sometimes destroyed and the contents of the organ effused; the duodenum is red and soft, the cæcum somewhat injected, but the intermediate intestine sound.[1] In general, however, the pain and general disturbance of the system produced by muriatic acid

[1] Compare Casper's Vierteljarschrift, xxvii. 361; St. George's Hosp. Rep., iii. 239; Arch. der Heilkunde, xiii. 214.

are less than other acids occasion. A case is recorded in which an ounce of the officinal acid was swallowed by mistake, yet the patient recovered.[1]

Remedial Uses. *Internally.*—In *typhus*, and in fevers of the *typhoid type*, this acid has been recommended by numerous authorities, of which may be mentioned Fordyce, Hufeland, Jahn, Flajani, and Voigtel. But in spite of their decided eulogy of its virtues, it would be difficult to infer from their statements in what its eminent virtues consist. The same, or a similar judgment, may be pronounced upon the reports of Dr. Chambers of a series of cases of "continued fever" treated on "general principles," and an equal series of the same disease, or rather diseases, treated by muriatic acid and a nutritious diet. Unless it were stated what treatment was employed under the suggestion of general principles, it is evident that no ground can exist for a fair comparison between the results of the two series; and this has not been done. If it were shown that a series of cases treated without any medicine and with a supporting regimen furnished a strikingly lower mortality than an equal series occurring at the same time and under the same general conditions, but in which muriatic acid had been freely administered, the question might be considered as affirmatively resolved; but not otherwise. Many writers eulogize the virtues of the acid in scrofula, etc. Ferriar[2] states that he employed it in hospital and in private practice as a tonic in cases of *scrofula*, *phthisis*, *dyspepsia*, and *general debility*, and always found its effects to be an acceleration of the pulse, an agreeable glowing sensation in the stomach, a feeling of increased vigor and alacrity, and a heightening of the complexion. These effects, and more besides, are ascribed to the medicine by Caron and by Malherbe,[3] who recommend that the pure acid should be diluted with one hundred and thirty parts of wine of cinchona or some other appropriate bitter, with the addition of wine of rhubarb if constipation is present, and a tablespoonful administered with water four or five times a day. If muriatic acid be, as it is asserted, a constituent of the gastric juice, its artificial increase in the stomach may promote the perfect solution and assimilation of the food, and in this manner tend to palliate or even cure diseases which frequently originate in a defect of the primary digestion.

In obstinate cases of *secondary syphilis*, when the digestive and nutritive functions are feeble and mercury cannot well be borne, muriatic, like nitric, acid may be given with advantage. In this country attention was early called to its anti-syphilitic virtues by Prioleau.[4] It has been a good deal used in cases of *stone* and *gravel*, and is generally prescribed theoretically for the phosphatic forms of these complaints. But in practice it seems to have been equally advantageous in lithiasis, a fact which must be attributed to its influence on the assimilative function, and its diuretic properties.

[1] Beck, Med. Jurisp., ii. 340.
[2] Med. Histories, Am. ed., p. 387.
[3] Bull. de Thérap., lxxiii. 377.
[4] Caldwell's Medical Theses, p. 104.

It has also been employed in the treatment of *diabetes.*[1] Paris found it a very efficacious medicine in preventing the generation of *intestinal worms*, after the bowels had first been cleansed of them. But nearly all tonic medicines have a like influence. Sachs also found it useful in the verminous fever of scrofulous children, particularly when associated with cinchona, quassia, etc. In some *diseases of the skin*, as chronic eczema, it was used internally by Erichsen with success.[2] Plenck recommended washes or ointments containing it in the treatment of tinea, itch, and psoriasis.

Externally.—In *diphtheria* it was first strongly recommended by Bretonneau. He used a mixture of one part of the acid to two parts of honey; but others have preferred the pure acid, applied by means of a mop made by fastening a piece of soft sponge to a wooden handle with waxed thread. The acid should not be allowed to touch any part except that actually covered with the exudation, lest it tend to spread the morbid action, and its excess should be removed by means of water containing soda, or magnesia. Richter[3] mentions having used this application very successfully in an epidemic of measles, in which many of the patients were attacked with *gangrenous stomatitis.* Where a milder stimulant action is required, it may be diluted with honey or with glycerin. It may also be administered in a gargle. The acid may be used after the same manner in *mercurial* and in *ulcerative stomatitis*, in hospital *gangrene*, in *scrofulous*, *scorbutic*, and other *ulcers* of low vitality, in *tinea capitis*, and in *frostbite.* For the last-named affection it was recommended by Linnæus. Foot-baths containing it have been prescribed in cases of *retrocedent gout.* For the removal of *warts* and small fungous growths it is often a successful application.

Antidotes.—The alkaline earths, soap, and, in the absence of these, the bicarbonates of the alkalies, or some albuminous liquid.

Administration.—For internal administration the officinal *diluted* acid is generally prescribed, in the dose of from twenty to sixty minims, largely diluted with some mucilaginous liquid, and imbibed through a tube. The stronger acid may be given in about one-third or one-half of that quantity. As a *gargle*, the latter acid may be prescribed in the proportion of one or two fluidrachms to twelve ounces of water, sweetened with sugar or honey.

ACIDUM NITROMURIATICUM.—NITROMURIATIC ACID.

ACIDUM NITROMURIATICUM DILUTUM.—*Diluted Nitromuriatic Acid.*

Preparation and Properties.—Nitromuriatic acid, the *aqua regia* of the older chemists, is prepared by mixing together three troyounces of nitric acid and five of muriatic acid. *Diluted nitro-*

[1] Lancet, Jan. 1854, p. 65. [2] Lond. Med. Gaz., 1846. [3] Op. cit., iv. 69.

muriatic acid contains half of the quantities of the acids just mentioned with enough of distilled water to make the mixture measure a pint. It should be kept in a cool place protected from the light. Nitromuriatic acid has the remarkable property of dissolving gold and platinum, metals which are insoluble in either of its components separately. Like its constituent acids, it acts as a powerful corrosive poison when taken pure and in large quantities. In smaller doses it is very apt to disagree with the stomach, and it readily attacks the enamel of the teeth. From the experiments of Scott[1] it appears that when mixed with the water of a warm bath, so as slightly to acidulate the latter, it is absorbed, greatly increasing the acidity of the urine, and, after several repetitions of the process, exciting a burning sensation in the mouth and throat, a considerable discharge of saliva, and superficial ulcers of the mucous membrane, with redness and swelling of the gums. The bowels also are more frequently moved, and there is sometimes an increased tendency to urination. The secretion of bile is said also to be augmented.

Uses.—Scott and also Guthrie[2] ascribed a curative efficacy to this acid in chronic enlargement of the *liver* arising from tropical diseases, in *scrofula*, secondary *syphilis*, and chronic *rheumatism*, and in old and indolent *ulcers;* but the confession of the former, in a postscript to his original publication, that identical results are produced by sponging the skin with chlorinated water, destroys much if not all of the value of his previous testimony, and justifies the comparative neglect into which the medical employment of the acid has now fallen. We have, however, seen marked advantages result from using nitromuriatic acid foot-baths in cases of slight jaundice accompanied with dyspepsia, hepatic tenderness, and hypochondriasis in several persons who used alcohol to excess.[3]

The *dose* of the stronger acid is three or four drops, and of the diluted acid from ten to twenty drops. Each must be given very largely diluted and with suitable precautions for protecting the teeth.

[1] Amer. Med. Recorder, i. 81. [2] Eclect. Repertory, viii. 157.

[3] *Nitromuriatic Acid Baths.*—It may prove useful as well as interesting to become acquainted with the preparation of these baths as they were used originally. The following are the directions (slightly condensed) contained in Dr. Ranald Martin's edition of Dr. James Johnson's work on "The Influence of Tropical Climates, etc."

"Take of hydrochloric acid, three parts; nitric acid, two parts; mix the two acids very carefully and slowly, and after twenty minutes, add of distilled water five parts, and mix the whole carefully.

"*For a general bath:* 1. Pour into the (wooden) bath five pailfuls of cold water; add sixty-four fluidounces of the prepared acid, and sufficient boiling water to raise the temperature to 96° or 98°. 2. The patient should remain in the bath for fifteen or twenty minutes, the temperature of the water being maintained as at first. 3. Immediately on leaving the bath the patient should be quickly and thoroughly dried with hot and dry towels, and be placed in a dry and warm bed. To prepare the second and following baths, on each occasion about one-third of the liquid should be removed, one quart of dilute acid added, and hot and cold water enough to raise the bath to the proper temperature. If the skin become irritated, less acid should be used in the succeeding bath.

"*The foot and sponging bath:* To two gallons of water at 98° to 100° six ounces of the diluted acid should be added, and the limbs covered with a sheet. During fifteen or twenty minutes the legs, thighs, hepatic region, and sides of the chest

Were the practical interest of the subject greater than it is, we might in this place consider the compounds of chlorine with metals which possess escharotic properties. Chloride of antimony and bichloride of mercury are discussed elsewhere. The chlorides of lead, gold, zinc, and platinum do not differ from them in any essential particular of their operation.[1]

ACIDUM CHROMICUM.—Chromic Acid.

Description.—Chromic acid is obtained by the action of sulphuric acid upon a solution of bichromate of potassa. A solution of sulphate of potassa results, and the chromic acid is deposited in acicular crystals, which, when dried, are of a bright orange-red or crimson color. They are deliquescent, very soluble in water, and have an acrid and styptic taste. Chromic acid contains one equivalent of metallic chrome and three of oxygen (CrO_3).

Action.—When this acid was first employed in surgery, by Dr. Ure, in 1845,[2] it was because this eminent chemist was familar with its uses as a powerful oxidizing agent. He therefore applied it to the removal of hæmorrhoidal tumors. When rightly managed, he found that so soon as its corrosive action was finished it passed into the state of an inert pulverulent sesquioxide. Subsequently Heller described its action as follows:[3] "It first renders the skin yellow, and then brown, and finally bluish-black; an elevated eschar then forms, one or two lines in thickness, which becomes detached in from twenty-four to forty-eight hours. Underneath, a grayish-white exudation exists, which soon gives way to healthy granulations." The surrounding parts are not much inflamed, and the pain is represented as being less severe than that occasioned by caustic potassa, Vienna paste, nitrate of silver, or, indeed, any other caustic. Its tendency to penetrate the tissues deeply suggests the propriety of using it in appropriate quantities and properly diluted. The energy of its action is well illustrated by Heller, who found that at a moderately high temperature, the acid very readily dissolved any animal tissue; indeed, mice and birds immersed in it completely disappeared within fifteen or twenty minutes, so that "no traces remained even of their hair, feathers, bones, or teeth." In 1857, Mr. Marshall published a somewhat similar account of its operation, mentioning as one of its advantages over other caustics that a solution of one hundred grains of the acid to an ounce of

should be constantly bathed by means of a sponge, and several folds of flannel, immersed in the bath, wrapped round the body. The baths should be repeated night and morning.

"The bath-tub should be of earthen ware or wood, and the sponges and towels washed in cold water to prevent their being destroyed by the acid."

A course of at least two months of such baths is recommended.

[1] For a full experimental Essay upon the caustic compounds of chlorine the reader is referred to a paper by Bryk, Virchow's Arch., xviii. 377.

[2] Lond. Med. Gaz., March, 1845, p. 787.

[3] Annuaire de Thér., 1853, p. 283.

distilled water does not burn nor permanently stain linen.[1] In 1864, E. Busch confirmed the statements concerning it of the writers already referred to,[2] dividing its grades of action into drying or astringent; superficially caustic, like nitric acid; and deeply caustic like the actual cautery.

Uses.—As before stated, this caustic was originally used by Dr. Ure for the destruction of *hæmorrhoidal* tumors. Heller employed it to remove new formations, and particularly large *condylomata* seated on the genital organs and the adjacent surface of the thighs. He surrounded the tumors with adhesive plaster so as to protect the sound skin from corrosion. Marshall cured by its means extensive *syphilitic warts* of the female genital organs, which even excision had failed to cure. Key applied it successfully to the removal of an immense *warty growth* affecting the nose and upper lip;[3] Crawcour to that of growths of the same description upon the scalp;[4] and Hairion to destroy the inodular or cicatricial tissue which exists after loss of substance in the conjunctiva.[5] A curious and interesting case is related by Caussade, of Bordeaux, in which this acid was successfully employed to destroy enormous *vegetations* of the vagina, cervix uteri, and labia. These excrescences followed a leucorrhœal discharge, which was not associated with any evidences of syphilis, and in a fortnight the cure was rendered complete by the application of a solution of one part of chromic acid in three parts of distilled water. It is remarkable that this disease occurred in a pregnant female, who, a week after her cure, was delivered without accident of a healthy child.[6] Busch recommends a solution of one part of the acid to two parts of water for "œdema of the skin, scrotum, and eyelids," (?) for engorgement of the neck of the uterus, and other chronic engorgements.[7] According to him it allays itching remarkably. Dr. Purdon, besides using it very successfully for condylomata, found it a prompt and certain cure for *tinea circinata*, *tinea tonsurans*, *sycosis*, etc., applied in a solution containing one part of the acid to eight of water. In *lupus*, also, it proved very efficient when used of the strength of two drachms to the ounce.[8] A concentrated solution, made by the addition to the salt of so much water only as will render it liquid, is advised for arresting surface *hemorrhage*, and as the most efficient means of rendering unhealthy *ulcers* apt to cicatrize. Of the former of these uses a striking example was mentioned to us by a physician of this city. A lady reduced to the last extremity by constant hemorrhage from the womb, for which no sufficient local or general cause could be assigned, was cured of her local ailment and its consequences by the insufflation into the uterus of a few drops of a concentrated solution of chromic acid. Dr. Wooster, of San Francisco, claims for this agent a superiority over all others as being the most

[1] Lancet, Jan. 1857, p. 88.
[2] Annuaire de Thér., xxiv. 229.
[2] Lancet, May, 1857, p. 489.
[4] N. Amer. Med.-Chir. Rev., ii. 156.
[5] Archives Gén., v. sér., xiii. 352.
[6] Boston Med. and Surg. Journ., Oct. 1859, p. 197.
[7] Annuiare de Thérap., xxiv. 229.
[8] Journ. of Cutaneous Med., ii. 40.

harmless of all caustics that can be applied to the interior of the uterus, and at the same time the most certain in curing *uterine hemorrhage*, and *uterine leucorrhœa*. He used a solution of fifteen grains of chromic acid to a fluidrachm of hot water, which he injected into the cavity of the uterus after dilating its neck so as to permit the free return of the injection, and prevent the risk of its passing into the peritoneal cavity.[1] Dr. Kinny reports favorably of this acid as a means of curing *incontinence of urine*, in females, due to an enlarged urethra. It was employed as follows: Having wiped the parts dry, and applied sweet oil over the surrounding tissues, a solution of equal parts of chromic acid and water is applied by means of a compressed cotton swab to the opening of the urethra, to the parts immediately around it, to the extent of a quarter of an inch, and for three-quarters of an inch to the interior of the urethra. A slough comes away in a few days, and then the urethra contracts rapidly. In one case complicated with a fungous growth at the orifice of the urethra, the relief was only partial.[2] In a case similar to the one last mentioned, we also found that the treatment only palliated the infirmity.

Application.—The acid may be applied by means of a glass or porcelain rod or spatula to the diseased surface, and great care should be taken to protect adjacent soft parts by means of adhesive plaster or compresses or oil. Its strongest action is obtained by the addition of so much water only as may be necessary to form a thick paste. Any superfluous acid may be removed by a piece of wet lint. A piece of the same material, dry, is the best dressing after cauterization. Weaker solutions, as of one hundred grains in a fluidounce of distilled water, may be applied by means of a camel's hair brush, which should immediately afterwards be washed in water.

Bichromate of potassa exerts in a milder manner many of the actions which have been ascribed above to chromic acid. It should therefore have the preference of a first trial in all cases in which the stronger escharotic operation of the acid is not peremptorily required. We have seen it act decidedly as a caustic upon the delicate integument behind the corona glandis, when applied for the removal of venereal warts.

ACIDUM SULPHURICUM.—Sulphuric Acid.

Acidum Sulphuricum Dilutum.—*Diluted Sulphuric Acid.*

Acidum Sulphuricum Aromaticum.—*Aromatic Sulphuric Acid.*

Acidum Sulphurosum.—*Sulphurous Acid.*

History.—Sulphuric acid was discovered in the middle ages, and is mentioned by Basil Valentine (1415?).

[1] Am. Journ. of Med. Sci., Oct. 1869, p. 367. [2] N. Y. Med. Record, vi. 129.

Natural Sources.—It is found as a product of the sulphurous soil in certain volcanic regions. In 1776 it was detected by Baldassari in the hill of Toccolina, near Sienna; Humboldt discovered it in New Grenada, in the waters of the Rio Vinagro, whose name is derived from the sour taste its waters acquire from this acid.[1] Dr. Thomson states that in Persia there is an earth so strongly impregnated with it as to be used for an acidulous seasoner of the food.[2] Vauquelin detected it in the water of a lake in the island of Java.[3] In the United States the Sour Springs, near Byron, N. Y., owe their name to the sulphuric acid contained in their waters.

Manufacture.—The sulphuric acid of commerce is prepared by burning a mixture of sulphur and nitrate of potash or soda in an atmosphere filled with watery vapor. Sulphurous acid and nitric acid gas at first are generated, and by mutual reaction are converted into sulphuric acid and nitrous acid, which latter, acting upon the newly-evolved sulphurous acid, converts it into a fresh portion of sulphuric acid.

Properties.—Sulphuric acid, in popular language *oil of vitriol*, is a dense, colorless, inodorous, and transparent liquid of an oleaginous appearance. Its sp. gr. is 1.843, and it freezes at about 15° below zero. Owing to its singular facility for absorbing moisture from the air, it is liable to increase very greatly in volume, and on this account the vessels containing it ought to be kept carefully closed, and not entirely full.

Diluted Sulphuric Acid consists of two troyounces of the stronger acid diluted with sufficient water to measure a pint. Its sp. gr. is 1.082.

Aromatic sulphuric acid, or *elixir of vitriol*, is made with six troyounces of sulphuric acid, two pints of alcohol, ginger and cinnamon. It is regarded as an alcoholic solution of sulphuric acid flavored with aromatics. "It has a peculiar aromatic odor, and, when sufficiently diluted, a grateful aromatic taste." It is a more agreeable form for internal administration than the simple diluted acid.

Sulphurous Acid is prepared by depriving sulphuric acid of one equivalent of its oxygen by means of charcoal and heat, and saturating distilled water with the resulting gas. It is a colorless liquid of a sulphurous and sour taste, and of sp. gr. 1.035.

Action. *On Vegetables.*—In a concentrated state sulphuric acid abstracts the water of plants, and carbonizes woody fibre; even when diluted it soon destroys their vitality.

On Animals.—When sulphuric acid is injected into the veins of an animal, it causes instant death by coagulating the blood. When introduced into the stomach, the animal seems to suffer extreme pain, strives to vomit, utters plaintive cries, and, if restrained, struggles to free itself. If vomiting occurs, it is of a fluid contain-

[1] Mérat and De Lens, Dict. de Thérap., vi. 458.
[2] Mat. Med , i. 361.
[3] Thomson, Dispensatory, p. 174.

ing liquid or partly carbonized blood, and the accidental contents of the stomach. On dissection, the œsophagus is found more or less blackened and inflamed, the mucous membrane of the stomach is ulcerated, softened, or in great part destroyed, and the walls of the organ may be entirely perforated by the acid. The blood contained in the heart is more or less firmly coagulated, and sometimes that also in the pulmonary vessels.[1]

On Man.—The action of sulphuric acid upon the organism depends in a great degree upon its concentration. When applied boiling to the living tissues, it destroys them like red-hot iron; but sufficiently diluted for internal administration, its action is tonic, astringent, and inspissating, both locally and generally, for it is absorbed by the bloodvessels. It strengthens the appetite, quenches the thirst, and acidifies, to a greater or less extent, the secretions and excretions—the milk and urine, for example—lessens the frequency of the pulse, and renders the blood darker and more coagulable.[2] Although it does not itself pass off by the urine unless given in considerable quantities, it causes an excess of other acids in this secretion. Dr. Bence Jones is of opinion that the acid is first absorbed by the stomach, and afterwards eliminated from the system by the surface of the bowels.[3] By habitual use this acid becomes very injurious to the teeth, even when greatly diluted: it whitens them, indeed, but also corrodes them. It also, sooner or later, enfeebles the digestion, produces colicky pains and diarrhœa, and impairs nutrition. Marasmus, and even death, may be the ultimate result of its use.

In its more concentrated form sulphuric acid is a powerful escharotic, attacking the tissues violently in consequence of its affinity for their organic bases, as well as for the water with which they are combined. When the strong acid has been swallowed in poisonous doses, it occasions a burning pain in the mouth, fauces, œsophagus, stomach, and bowels, with nausea, violent retching, vomiting of dark, bloody, and sometimes membranous substances (which produce effervescence, if they happen to fall upon a marble hearth), and on examination are found to consist of portions of the epithelial and mucous coats of the stomach, together with all the signs of acute inflammation, and, unless the action of the poison be arrested, gangrene of the stomach, and death. The general symptoms are alteration of the voice, fetid breath, coldness of the extremities, and usually a small pulse, hurried or difficult breathing, inability to swallow, intense anxiety, and intolerable pain. The mind usually remains clear to the last. After death the parts attacked by the acid are found covered with a corrugated crust of a white, yellow, brown, or even black color, and the subjacent membranes are often perforated, sphacelated, carbonized, or merely thickened, puckered, or wrinkled, according to their being more or less exposed to the

[1] Orfila, Toxicologie, i. 126. [2] Wibmer, Wirkung, etc., v. 309.
[3] Headland, On the Action of Medicines, p. 301.

first attack of the acid. The adjacent vessels are distended with dark and coagulated blood. The blood has been found coagulated even in the distant arteries, the tibial for instance. This effect may serve to explain several of the striking symptoms produced by the acid, such as the dyspnœa, the small or imperceptible pulse, the icy coldness of the whole body, the spasms of the muscles of the extremities, etc. Sometimes the urine is albuminous or bloody, and the kidneys present evidences of an inflammatory process.[1] A case is reported[2] in which the corrosive action of the liquid was confined to the respiratory apparatus, the digestive organs having entirely escaped.

When the poison has been less energetic, or an appropriate treatment of its effects has been early resorted to, life may be preserved. The sloughs which it has produced may be cast off, and the ulcers may heal, but often with considerable thickening, hardening, and contraction of the tissues. In some cases death ultimately takes place as the result of stricture of the œsophagus, of ulceration and suppuration of this organ, or of the stomach, etc. Commonly there is also obstinate constipation, a scanty secretion of urine, and an augmented flow of saliva.[3]

Remedial Employment. *Externally.*—Owing to the difficulty of restricting the action of sulphuric acid, its powerful escharotic action is very seldom resorted to. It may, however, from this very quality, be more appropriate than solid caustics as an application to *poisoned wounds*, such as those made by venomous serpents, mad dogs, and other animals. It has been used as a caustic in *ectropion* and *entropion;* in the latter by Helling and Quadri, and in both by Guthrie, Lawrence, and others. In entropion it is applied in the following manner. The skin of the inverted lid, to the breadth of about three lines, and one line from its tarsal edge, is rubbed with the acid, by means of a pencil of wood dipped in it, with the precaution of not taking up more than merely wets the pencil. After ten seconds the part is to be dried, and the acid reapplied, and this even a third or a fourth time, until a sufficient eschar has been formed, or marked contraction has taken place. The part is then to be carefully washed.[4] Of remedying the other deformity, Mackenzie says: "Some surgeons venture on the employment even of sulphuric acid for this purpose. The blunt end of a common silver probe is dipped in that fluid and rubbed upon the conjunctiva of the lid, carefully avoiding the punctum lachrymale, caruncle, semilunar fold, and eyeball. The application should be repeated every fourth day."

[1] Virchow's Archiv, xxii. 237. [2] Lond. Med. Gaz., June, 1850.

[3] For cases and discussion compare HABERSHON, Times and Gaz., Nov. 1855, p. 470; Ibid., Feb. 1863, p. 183; Ibid., Dec. 1857, p. 629; Ibid., April, 1860, p. 408; POPHAM, Dublin Quart. Journ., May, 1856, p. 481; WINN, Lancet, Dec. 1857, p. 579; OGLE, Trans. Pathol. Soc., xi. 294; Henke's Zeitschrift, lxxviii. 216; Ibid., lxxxiii. 176; St. George's Hosp Rep., iii. 239; HALDANE, Edinb. Journ., vii. 739; Ibid., viii. 375; MANNKOPF, Prager. Viert., lxxxiv. Anal. p. 19; WYSS, Archiv d. Heilkunde, x. 184. The last named article contains an elaborate report and analysis of a remarkable case.

[4] MACKENZIE, Diseases of the Eye, p. 227.

Appropriately diluted, this acid has been employed in a great variety of *ulcerations*, *venereal*, *cancerous*, *and scorbutic*, and particularly when a stimulant astringent is required to favor the separation of *sloughs*, or *fibrinous exudations*, or to render the reparative process more active. But in none of these cases is the application as advantageous as that of nitrate of silver. Its superior astringency may, however, give it the preference in certain flabby and ulcerated conditions of the skin or mucous membrane, and particularly of the *throat and mouth*. It has been recommended in *gangrene* of the latter by Van der Woorde, who regarded it as the most efficient of all local applications, and by Van de Weil, Jourdain, Brunneman, Courcelles, and others.[1] Mr. Pollock claims for this acid superior efficacy as an application for the more speedy removal of dying bone, for the more rapid separation of dead bone, and for the destruction of the surface of *carious cavities*, and the disintegration of the dead bone lying therein. He holds its application to be simple and safe, to possess antiseptic qualities, to be comparatively painless when applied to carious bone, and seldom productive of irritation in the adjoining tissues.[2]

In 1871 attention was called to a method of extirpating tumors which Mr. Bell had purchased from a French charlatan. It consisted of saturating asbestos reduced to a fine powder with strong sulphuric acid, and thereby forming a paste which was applied, to the thickness of half an inch, upon the surface of the tumor to be removed. Rapid destruction of the tissue follows, with, after the first half hour, but little pain. After twelve or fourteen hours the first application is removed, and a new portion of smaller size adapted to the sore. It is claimed for this method, as for other similar ones, that it is less painful than the knife, inflicts a slighter shock upon the system, and more certainly extirpates the morbid growth.[3]

In several *diseases of the skin* sulphuric acid has been found useful. An ointment composed of one part of the acid to eight parts of lard was recommended by Crampton for *tinea capitis*, and the late Prof. Chapman stated that he had cured the disease by its means. A *sulphurous acid* lotion composed of one part of the acid to three of water has been successfully employed in the treatment of *favus*, and other forms of parasitic skin disease. The dead cryptogamic growth should first be removed by means of emollient poultices. It may be used internally to correct *dyspeptic fermentation*, but is less convenient for this purpose than the sulphites. As a lotion for recent *wounds* it has been thought to allay pain, diminish suppuration, and promote cicatrization. The use of sulphuric acid for *itch* seems to have originated with Coethenius, a Prussian army surgeon, in 1756, and it has since enjoyed considerable favor among the physicians in charge of hospitals for the treatment of skin diseases.[4] Helwich, Bry, and Sedillot, are referred to by the

[1] N. Amer. Med. and Surg. Journ., xi. 389.
[2] Lancet, May, 1870, p. 762.
[3] Practitioner, vi. 377.
[4] J. P. Frank, Path. Med., ii. 279.

author last quoted, and Fournier[1] cites Lentin and Sala in evidence of its successful employment. Alibert prescribed it in conjunction with the alkaline sulphuret, and Dupuytren used a similar combination. The ointment of sulphuric acid, says Neligan, seldom fails to cure the disease.[2] Eberle states that he repeatedly used a similar ointment with prompt success in itch, and also in a very distressing case of *prurigo formicans*. Chapman says that he removed itch by means of sulphuric acid lotions almost as speedily as with ordinary sulphur ointment. Over this preparation it has the important advantage of leaving no unpleasant smell, of not soiling the linen, and at the same time of allaying the itching quite as well.

Internally. Hemorrhages.—In those cases of hemorrhage which arise from "dissolution" of the blood, sulphuric acid has been profitably administered, particularly in *scurvy* and in *purpura*. It is certainly superior to all other mineral acids in these affections. Chapman is of opinion that it is sometimes effectual in restraining moderate uterine losses. According to Headland[3] it is particularly efficient in hemorrhages from mucous membranes, because it probably passes off in small quantities from all mucous surfaces. For the same reason, perhaps, it is useful in diarrhœa, as will appear below.

Fevers.—In fevers of a typhoid type, drinks acidulated with sulphuric acid have been generally given when there was no tendency to diarrhœa. The symptoms which indicate its exhibition are, according to J. P. Frank, flushed cheeks, burning skin, dry tongue, thirst, hemorrhage, or profuse sweats. It might rather be said that the stage and phenomena which follow these, and of which the symptoms are a dusky complexion, dry, harsh skin, black tongue and hemorrhage, call for the remedy, if it is needed at all, of which, indeed, there is much doubt. It must not, however, be concealed that some of the most eminent historians of this form of continued fever have attached great value to the use of sulphuric acid in its treatment. Among late writers, Neumann prefers it to all other acids. But he recommends it to combat the very opposite condition to that just described, at the commencement of the attack; when there is active delirium, and a full pulse gives the disease an inflammatory aspect, nothing, he says, will so soon dispel this semblance as sulphuric acid.[4] The diluted or the aromatic sulphuric acid is often used for palliating the *colliquative sweats* of phthisis, particularly when associated with quinia. This effect would seem to depend upon the fact that it is partly eliminated from the system by the skin. It ought not usually to be given if diarrhœa is present. In other cases of profuse sweating, those in particular which depend upon general exhaustion, the usefulness of this remedy is more decided.

In *dyspepsia*, accompanied by alkaline pyrosis, it is useful by its

[1] Dict. de Méd. en 60 vol., xvii. 210.
[2] Dis. of the Skin, Am. ed., p. 115.
[3] Action of Medicines, p. 303.
[4] Heilmittellehre, p. 35.

direct chemical action, but not in this manner only, for it is no less serviceable when the excessive secretions of the stomach are acid. Doubtless its astringency acts upon the muscular fibre of the glands of the stomach, and in this way diminishes their secretion.[1]

This acid is mentioned by numerous writers as having been employed by Sydenham in *diarrhœa*. At the London Hospital the following mixture has been found more efficient in the treatment of out-patients than any other. When the stools are scanty and frequent, the administration of the acid is preceded by a dose of castor oil. When they are abundant and watery, the acid is prescribed at once. ℞.—Acid. sulph. arom. ♏xx; tinct. camph. comp. ʒj; ætheris chlorici ♏x; spt. menth. pip. ʒss; syr. rhœados ℥j; decoct. hæmatox. ℥j. To be given every four, five, or six hours, according to the urgency of the diarrhœa. If the diarrhœa is followed by griping pains in the bowels, they are best relieved by a small dose of castor oil, with some aromatic. Of late years quite a number of reports have been published of its efficacy in *cholera morbus*. It would appear that the cases in which it is most efficient are such as are independent of crude ingesta, those, in other words, which arise from atmospheric influences, and particularly such as assume the epidemic type of the affection, and resemble cholera. Dr. Miller[2] seems to have employed the following formula with success. ℞.—Acid. sulph. dilut. ʒij; tinct. cardamom. c. ʒij; aq. destillat. ℥vss.—M. S. Take two tablespoonfuls at once, after every liquid stool or vomiting, and every four hours. Dr. Braithwaite[3] was no less successful in a large number of cases which approached in their character very closely to spasmodic cholera. He gave one minim in a tablespoonful of water to adults, and to children one-third of a drop. Under its use bilious matter returned to the discharges, and warmth to the surface; but the cramps were not affected by it. In Austria a specific for cholera was used under the government patronage, and, it is said, with great success. It contained as its principal ingredient sulphuric acid, mixed with about half its weight of nitric acid. A caution should be observed in treating bowel affections with sulphuric acid, which is, not to persevere in it if the first few doses fail to mitigate the symptoms, for in that case it is almost certain to aggravate them.

Lead Colic.—The treatment of this disease by sulphuric acid was first proposed by M. Gendrin, who was induced to do so by observing the success of alum (sulphate of aluminium and potassium), which had long been used for the same purpose. This was in 1830, since when M. Gendrin treated many hundreds of patients with sulphuric acid alone, and with nearly invariable success.[4] The duration of the cases seems to have been about three days in slight, and six or seven in severe ones. Forty-four drops of the acid were mixed with a pint of water, and two or three times this quantity

[1] Headland, op. cit., p. 302. [2] Lancet (Am. ed.), Dec. 1852, p. 424.
[3] Times and Gazette, Dec. 1852, p. 629; Pretty, ibid., Nov. 1853, p. 512.
[4] Bennett, Lancet, March, 1856, p. 378.

was taken in the twenty-four hours. No other medicine was administered, but the patients used warm sulphur baths every day, by which the lead excreted upon the skin was turned black, and being thus rendered visible, was the more easily removed. This process, which was repeated until all traces of lead disappeared from the skin, no doubt forms an important element of the treatment, because it removes the poison which would else be absorbed anew.

Sulphuric acid was also proposed by Gendrin as a prophylactic against *lead poisoning*, and his observations seemed to justify the proposal. In the same way Mr. Benson, of the Birmingham Lead Works, inferred from his experience that the acid is in a high degree efficient. It certainly seems to have had the effect of diminishing the number of attacks of lead colic in his manufactory.[1] These results, it must be confessed, are met by opposing testimony, which appears to be more decisive. Tanquerel[2] has shown that those of the workmen in lead who use sulphuric acid drinks are sooner attacked than those who abstain from them, and Grisolle[3] arrives at the same conclusion, which, indeed, an impartial estimate of the facts of the case seems to warrant.

Sulphuric acid has sometimes been used for *gravel* and *stone*, and perhaps with advantage in so far as it improved the tone of the digestive organs, and thereby restored the normal composition of the urine. Injections containing rather less than a drop of the diluted acid to an ounce of water, have been successfully applied to the cure of *gonorrhœa* by Dr. Miller, of Virginia.[4]

This acid has been recommended in a great variety of affections, including those of a convulsive form, and even in *epilepsy*, *hypochondriasis*, *hysteria* with profuse menstruation, chronic *singultus*, chronic *vomiting*, morbid *sensibility of the stomach*, *etc.* Some cases of *tapeworm* are reported, which appear to have been cured by aromatic sulphuric acid in the dose of a fluidrachm, largely diluted, and repeated three or four times a day.[5]

It has been alleged by Brühl, Cramer, Roth, and others, in Europe, and by Dr. Brinklé in this country,[6] that when the acid is administered in a bitter decoction, or in their usual drinks, to habitual *drunkards*, it destroys the appetite for alcoholic liquors. But this statement, it must be feared, has not been sustained by experience. When drunkards have been prevailed upon to acidulate with it all of the alcoholic drinks taken by them, they certainly have sometimes become disgusted with the mixture; but perhaps in no case have they been permanently restrained by it from indulgence in their former draughts.

Antidotes.—The best are chalk, magnesia, carbonate of magnesia, and the alkaline bicarbonates. The alkaline carbonates

[1] Lancet, Dec. 1842, p. 435.
[2] Maladies de Plomb., ii. 497.
[3] Essai sur la colique de Plomb., p. 66.
[4] Philad. Med. Record., v. 765.
[5] Am. Journ. of Med. Sci., Oct. 1860, p. 377.
[6] N. Am. Med. and Surg. Journ., iv. p. 293.

are thought to be objectionable because they are themselves corrosive.

Administration and Dose.—When given internally, sulphuric acid must be largely diluted. One or two drops of the strong acid dissolved in eight fluidounces of water is about the average dose. Of the diluted and aromatic acids from ten to thirty drops in a wineglassful of water may be given three or four times a day through a glass tube. Sulphurous acid may be given internally, in the dose of from one to three fluidrachms largely diluted with water.

IRRITANTS CHIEFLY ALKALINE.

AQUA AMMONIÆ FORTIOR.—Stronger Water of Ammonia.

Aqua Ammoniæ.—*Water of Ammonia.*

Spiritus Ammoniæ.—*Spirit of Ammonia.*

Spiritus Ammoniæ Aromaticus.—*Aromatic Spirit of Ammonia.*

Preparation.—*Stronger water of ammonia* is prepared by saturating water with ammonia, procured by the reaction between chloride of ammonium and slaked lime. It has a sp. gr. of 0.90. By the addition of distilled water the sp. gr. of the solution is raised to 0.960, forming *water of ammonia.* The former is chiefly employed to produce vesication, either alone or in combination with lard (*see below*, the vesicating ointment of Gondret), or else united with oil or with tincture of camphor. *Liniment of ammonia* is composed of water of ammonia a fluidounce, and olive oil two troyounces. *Spirit of ammonia* is made by impregnating alcohol with ammonia. *Aromatic spirit of ammonia* is prepared by dissolving carbonate of ammonium in water of ammonia, previously diluted, and adding to the solution the oils of nutmeg and lavender.

Action. *On Plants.*—The vapor of ammonia causes plants which are exposed to it to shrivel and fade.

On Animals.—If an animal is immersed in ammoniacal gas, it dies asphyxiated. In experiments performed by Mitscherlich,[1] rabbits were destroyed within three hours by two drachms of caustic water of ammonia. It occasioned uneasiness, great frequency of pulse, rapid breathing, and such prostration that the animal was

[1] Lehrbuch der Arzneimittellehre, ii 277.

unable to rise, and stretched itself out upon its belly. Tetanus followed, and a lingering agony. The stomach was found to contain a large quantity of reddish mucus, and its lining membrane was softened; the poison having penetrated the vessels, had dissolved the blood-corpuscles, and determined an exudation of their coloring matter, so that the fluid in the stomach contained only this matter, together with the cells of the peptic glands and mucus. In the small intestine there was much bloody mucus. The blood of the whole body was more or less fluid, and coagulated very slowly, forming a soft small clot. Its alkaline reaction was not greater than usual, and the blood-corpuscles, except those mentioned, retained their normal form. The bloodvessels of the stomach and small intestine were greatly distended with liquid blood, which in some places had penetrated the tissues and stained the peritoneum red. When two drachms of water of ammonia were thrown into the peritoneal cavity of a rabbit, the same general symptoms as those just described were produced, except that there were evidences of greater suffering. The caustic dissolved the blood-corpuscles in the wound, and penetrated through the walls of the vessels, and even of the intestines, producing the same changes as when administered by the mouth, and in particular the softening of the lining membrane of the small intestine. The blood was not rendered more alkaline than before, and the urine continued to have an acid reaction. From these experiments Mitscherlich concluded that caustic ammonia, in large doses, corrodes and liquefies the solids; that it is not excreted by the bowels; that it renders the blood less coagulable, and dissolves the blood-globules when it comes into contact with them; that it does not render the urine alkaline, nor increase the alkalinity of the blood; that it exerts a specific action upon the mucous membrane of the small intestine; that it is not only absorbed by the bloodvessels, but also penetrates the tissues directly; and that it causes death by its action upon the blood and indirectly upon the spinal marrow.

On Man. Externally.—Different preparations of ammonia act with various degrees of intensity upon the skin, producing rubefaction, vesication, or merely softening of the cuticle. When caustic ammonia is applied to the skin, it excites a sense of warmth, followed by a burning pain, and, if the cutis be delicate, or the application continued, a true inflammation, with more or less vesication. In two persons a space on the back of the hand was kept moistened with water of ammonia of sp. gr. 0.905, and containing about 27.5 per cent. of ammonia. At the expiration of nine minutes a smart pricking and burning sensation was felt; in twenty-five minutes the burning was stronger and the skin red; in half an hour small vesicles were perceptible, which gradually enlarged and coalesced, and formed, at the end of three-quarters of an hour, a large bulla. It was at first, however, but imperfectly distended. The adjoining skin was quite red. After allowing the surface to get dry, the pain and redness continued, the blister grew more tense, and afterwards

shrivelled and got well like blisters from other causes.[1] The ammoniacal ointment of Gondret, when well prepared, produces a momentary sense of coolness in the skin, followed by heat and smarting. This sensation is said to be far less painful than might be supposed from the rapidity with which vesication occurs; indeed, it seldom excites complaint. In from five to fifteen minutes, according to the susceptibility of the skin, the cuticle is raised into a single bulla, or else the serum is contained in several vesicles joined together.[2] If, when the fluid is evacuated and the cuticle removed, a simple dressing be applied, there will be found, after the lapse of a few hours, an albuminous exudation, the thickness and tenacity of which will depend upon the strength of the ointment and the duration of its contact with the skin. If it be intended to constitute the surface an absorbing medium for medicinal agents, this membrane must be removed; or if the object be to establish a permanent exutory, a somewhat longer application of the ointment will produce an eschar.

Internally.—The vapors of ammonia, even when much diluted, excite a flow of tears, with inflammation of the eyes and irritation of the air-passages, if applied to these parts. If they are long inhaled, as they are apt to be when employed to arouse persons from a state of insensibility, serious, and even fatal, consequences may ensue. Nysten tells us that a physician, for some years subject to epilepsy, was found by his servant in a fit. In order to arouse his master, the latter applied a handkerchief, moistened with solution of ammonia, to his nose so assiduously that he brought on bronchitis, of which the patient died on the third day. In the *Edinburgh Medical and Surgical Journal* there is the report of the case of a lad whose death was produced, or at least hastened, by an attendant applying ammonia to the nose, "with such unwearied but destructive benevolence," that suffocation had almost resulted. Dyspnœa, with severe pain in the throat, immediately succeeded, and death took place forty-eight hours afterwards. A French physician also suffered ulceration of the mouth and violent pulmonary catarrh in consequence of the excessive use of ammonia, given as an antidote for hydrocyanic acid. More recently another case of poisoning by the vapor of ammonia has been published. It arose from the accidental bursting of a carboy of liquor ammoniæ. The mucous membrane of the nose and lips was destroyed. The tongue was deprived of its epithelium, and a large quantity of sanguineous froth escaped from the mouth. The respiration was so difficult that suffocation was feared. The pulse was feeble, irregular, and frequent. There were no convulsions. Bronchitis supervened, but the patient recovered.[3]

When liquid ammonia is taken by the mouth, different symptoms present themselves. Wibmer found[4] that five drops or less of it

[1] Mitscherlich, op. cit., ii. 282.
[2] Trousseau and Pidoux, Thérapeutique, i. 369.
[3] Pereira, Mat. Med., 3d Am. ed., i. 429.
[4] Wirkung, etc., i. 124.

produced no effects beyond a sense of irritation or burning in the throat, but that doses of from ten to twenty-five drops caused a feeling of extreme tension in the temples, which lasted for several minutes; the pulse was somewhat more frequent and rather harder in some of the experiments, but in others it remained unchanged. To these phenomena may be added a general enlivening of the feelings, a sense of increased strength, augmented warmth of skin, a flow of perspiration and urine, and in bronchial affections a greater abundance of sputa and ease of expectoration.[1] The tendency of the medicine to produce diaphoresis may, as in other similar cases, be greatly increased by the use of warm drinks and external warmth. These effects, it will readily be perceived, are very unlike those produced by diffusible stimulants, particularly of the alcoholic sort. Ammonia does not, like wine and opium, excite the circulation nor stimulate the mental faculties, nor does any evident depression follow the transient excitement of the secretory and motor functions which it occasions. Indeed, its physiological action upon the healthy system is extremely slight and fugacious; but when the nervous system, and with it the circulatory and secretory functions are enfeebled, the evidences of its power are incomparably more distinct.

When given in large doses, caustic ammonia may act as a deadly poison, yet cases of its toxical effects are comparatively rare, because, no doubt, its penetrating odor prevents its being often swallowed by mistake. Yet it is sometimes taken in this way. Plenck relates that a man who had been bitten by a mad dog had administered to him a glassful of ammonia. His lips, tongue, and gums turned black immediately, and he died within four minutes.[2] Several other cases may be alluded to, of which two are quoted by Dr. Taylor.[3] In one of them two drachms of the liquid caused violent vomiting and bloody stools; in a second, a drachm and a half was taken, and death, in excruciating agony, soon afterwards occurred. Another case is reported,[4] by Dr. Barclay, in which there were severe pain in the stomach and vomiting of blood, which continued for three days, after which the stomach continued to be excessively irritable, and the bowels obstinately costive. In four weeks the patient died from starvation. A fourth case may be mentioned[5] in which strong ammonia was taken with a suicidal intent. The symptoms were general collapse, serous and bloody diarrhœa, and bloody vomiting, clearness of the mind, excruciating pain in the abdomen, and death in six hours. In a more recent case a man seventy years of age "took two swallows of spirits of ammonia," was immediately seized with a sense of suffocation, cough and vomiting, and died within four hours; death being preceded by delirium, stupor, and spasms.[6] Finally, a drunken fellow drank

[1] STRUMPF, Handbuch, i. 845. [2] MITSCHERLICH, loc. sup. cit.
[3] On Poisons, Am. ed., p. 225. [4] Med. Times and Gazette, Nov. 1853, p. 553.
[5] Annales de Thérapeutique, iii. 443.
[6] Am. Journ. of Med. Sci., Jan. 1870, p. 275.

"about a teaspoonful of strong liquor ammoniæ." A few hours afterwards he complained "of a slight pain in the abdomen, turned over on his side, became blue in the face, and expired immediately, without any struggle for breath."[1] Dissection of the bodies of persons killed by this poison discloses marks of violent inflammation, sometimes of the pseudo-membranous form, in the fauces and œsophagus, œdema of the larynx in some cases, and occasionally inflammation of the bronchial mucous membrane, inflammatory redness, softening, or ulceration of the gastric mucous membrane, and, to some extent, of the small intestine also. The blood is generally dark and liquid.

But large doses, even, of ammonia are not always fatal, as the following cases will prove.[2] A wineglassful of strong water of ammonia was taken by a female, by mistake, for acetate of ammonia. As soon as she had swallowed it she fell back insensible, and as if strangled. Between four and five hours afterwards she complained of severe burning pain in the throat, epigastrium, and left hypochondrium, all of which parts were tender upon pressure. Her pulse was 53, and small, and her voice whispering. The debility was great, the countenance anxious, the pupils widely dilated; there was inability to swallow, the mucous membrane of the tongue peeled off, and there were convulsive twitches of the right arm. These symptoms gradually abated during the next three days, but a severe darting pain about the root of the nose continued, and diarrhœa afterwards came on, which, however, may have been due to laxatives which were injudiciously administered. In a fortnight the patient was convalescent. In another case, a girl swallowed an unknown quantity of the poison. She lay on the floor, her eyes closed, her hand moving automatically about the epigastrium. The under lip was enormously swollen, the neck red and tumid; breathing was labored, the teeth were set, the pulse and heart-beat were slow and intermittent; the mouth and throat were raw. Within ten days the woman was seen walking in the street.[3] In still another instance a lady took by mistake seven drachms of ammonia liniment containing two drachms of strong water of ammonia. She complained of severe pain in the throat, had a whispering voice, a pulse of 136, a hard hissing cough, pain in the chest, an excoriated tongue, mouth, and throat, with tender epigastrium and abdomen. There was no vomiting. Ulcers of the throat, exfoliation of the buccal epithelium, bronchitis, and hæmaturia followed, but ultimately, that is to say, within three months, complete recovery took place.[4]

Remedial Employment. *Externally.*—The use of ammonia as a counter-irritant seems first to have been proposed by Gondret in 1821. Three years later, M. Vaidy published an essay on the modus operandi of this application, and in 1838, Dr. Granville drew more

[1] Guy's Hospital Reports, 3d ser., xvii. 225.
[2] Wilkins, Lancet, 1846, i. 385.
[3] Virchow's Arch., xlv. 522.
[4] St. George's Hosp. Rep., v. 72.

general attention to its use by a popular essay "On Counter-irritation," in which the precise nature of the preparation employed by him was purposely concealed. It turned out, however, to be nothing more than strong water of ammonia diluted with spirit of camphor and spirit of rosemary to the extent of about one-half. The preparation became a popular remedy, and was sold in this country under the name of *Granville's lotion.*

In all cases requiring prompt vesication of the skin, caustic ammonia is of great utility. It is unnecessary to enumerate the particular cases in which it may be applied, for they include all in which the severity of the pain or the danger of delay calls for a prompt resort to counter-irritation. Such are *congestion of the brain or lungs*, the paroxysms of *rheumatism*, *chronic gout*, *neuralgia*, and *various spasmodic pains.* The mode of application and its effects must be determined by the peculiarities of each case. When full vesication is desired, Gondret's ointment forms the most powerful agent for producing it; if a superficial blister is sufficient, the strong water of ammonia may be applied; when rubefaction only is intended, one of the ammoniated liniments may be employed.[1] For local pains, of a rheumatic or neuralgic character, ammonia forms an excellent palliative, and when the attack is slight, or arises from temporary causes, it is sometimes curative. For *neuralgia*, the best mode of procedure is the following. Take small disks of cloth, about a half or three-quarters of an inch in diameter, and apply them, moistened with the ammonia, over such points in the course of the affected nerve as are tender upon pressure, or are the seat of spontaneous pain. Cover the pieces of cloth with coins, buttons, or other convenient bodies to prevent evaporation. Cotton contained in a thimble and saturated with the caustic liquid forms a still more convenient arrangement. As soon as slight vesication occurs, the pain is relieved, yet not so thoroughly as when the same effect has been obtained by means of cantharides. The addition of a salt of morphia to the vesicating liquid renders its effects more prompt and certain. The less active liniments, containing ammonia, are more appropriate for preventing the development of inflammation, particularly such as cold produces. In commencing *sore throat*, *laryngitis*, *pleurisy*, *rheumatism*, etc., brisk frictions with one of these preparations should be made in the neighborhood of the affected part.

Lavagna employed injections into the vagina, of ammonia (ten or twelve drops to an ounce of milk) for the purpose of restoring *sup-*

[1] The vesicating ointment of Gondret, as improved by M. Trousseau, is prepared in the following manner. Take of fresh lard and of ammonia, at 22°, each four drachms, and of tallow from half a drachm to one drachm. Melt the lard and tallow in a wide-mouthed bottle, dipped into hot water for this purpose. After removing it, and as soon as the mixture begins to assume an opalescent appearance, add the ammonia, stop the bottle, and shake it until the contents acquire a creamy consistence, then cool it in water. If, instead of having a uniform consistence, the mixture contains lumps, it must be prepared anew, for this condition denotes the presence of uncombined water of ammonia. Unless great care be taken, this preparation will produce a more or less superficial slough and a permanent cicatrix. For these reasons, it should seldom be employed upon the face or other exposed portions of the body.

pressed menses. Sometimes the discharge returned within twenty-four hours, and sometimes not for five or six days. The injection produced an unpleasant sensation and sometimes even pain, with a white discharge, but no further annoyance.[1] Mérat and De Lens state that it proved unsuccessful in the only case in which they employed it.[2] They, however, used it with advantage in several cases of simple *leucorrhœa.* In nervous *debility of the eyes*, and commencing *amaurosis* produced by fatigue of these organs, or by their exposure to an intense light, the vapors of ammonia, very carefully diluted, may be inhaled by the nostrils, or allowed also to act gently on the globe of the eye itself. This method, although very useful, and recommended by some very high authorities, of whom Scarpa may here be cited,[3] is believed to be inferior to that by vapors of sulphuric ether employed in the same manner. *Burns* that do not involve the true skin may be cured, according to Guérard, by water of ammonia applied upon compresses. Simple exclusion of the air by raw cotton is more certain and less painful. *Frost-bite* in its first stage is more readily relieved by local stimulants than by any other means; and the ammoniated liniment is one of the best. In *febrile affections* of a low type, and whenever there exists a general depression of the economy, whether it be primarily dependent upon blood disease or upon nervous debility, much benefit may be derived from sponging the whole surface of the body with hot water containing ammonia. It may be simultaneously exhibited internally, as recommended in the next paragraph.

Internally.—In protracted *idiopathic fevers*, with prostration, dulness of the intellect, and a want of vitality in the skin, this medicine forms a useful adjuvant to alcoholic and nutritive stimulants, and stimulant diaphoretics. In *exanthematous fevers* when the eruption is tardy or imperfect, in *intermittents* during the cold stage, etc., water of ammonia has been recommended as a stimulant,[4] but it is less effectual than the carbonate of this alkali. In all fevers which tend to debility of the system, the solution of acetate of ammonia is preferable to any other diaphoretic.

It has been proposed to use inhalations of ammoniacal vapor in the forming stage of *coryza*, *tonsillitis*, and even *pulmonary catarrh*, and they may undoubtedly be serviceable if judiciously employed. Mr. Smee[5] recommended the use of ammoniacal inhalations very strongly, and devised an inhaler for their more convenient administration. Of the proper strength of the solution to be used he says: "It is preferable not to employ a solution stronger than the liquor ammoniæ of the shops, or weaker than the same diluted with twenty or thirty times its quantity of water." The value of this remedy is seen, according to Mr. Smee, in relieving *dryness of the throat* with an accumulation of hardened mucus in the fauces; *chronic hoarseness*, especially that which often follows influenza; the relaxed and

[1] Vogt, Pharmakodynamik, i. 226.
[2] Dictionnaire de Mat. Méd., i. 239.
[3] Bull. de Thérap., xliii. 135.
[4] Strumpf, Handbuch, i. 854.
[5] Lond. Med. Gaz., March, 1843, p. 59.

semi-œdematous state of the pharynx and larynx, which often affects public speakers and others exposed to the hot and impure air of crowded rooms; commencing *tonsillitis;* old standing cases of asthma (those, probably, which depend upon emphysema or catarrh of the lungs); and morbid susceptibility of the respiratory tubes to the impression of cold air. It also acts as an antidote to the vapor of *bromine* and of *prussic acid.* In any of these cases the presence of acute inflammation or of marked fever forms a contra-indication to the use of the remedy. Under very similar conditions of the larynx and respiratory tubes, ammoniacal cauterization of the fauces was resorted to by Hervieux and Rayer.[1]

Moderate degrees of *sourness of the stomach* with an extrication of gas in this organ, especially when it results from constitutional debility of the nervous system, are greatly relieved by a few drops of the aromatic spirit of ammonia in water. At the same time it calms the nervous agitation which commonly attends this state. In veterinary medicine, ammonia is employed with complete success to relieve gaseous distension of the paunch (*tympanitis*) in ruminating animals that have fed too largely upon certain kinds of grass or upon fermenting hay.

In *spasmodic coughs*, generally, and in *whooping-cough*, especially, it may, in combination with antispasmodic medicines, serve to palliate the violence of the paroxysms. Such cases, however, of its curative effects as have been reported by Levrat-Perroton,[2] are altogether inconclusive. It has also been thought useful in *epilepsy.* Pinel saw an attack prevented by ammoniacal inhalations. The patient (a watchmaker) had intimations of the approaching paroxysm from certain feelings; but he found that, by inhaling the vapor of ammonia, it was frequently prevented. In the case of a confirmed epilepsy, which Pereira was in the habit of watching for some years, he believed that he had seen analogous beneficial effects.[3] Herpin states that this method sometimes succeeds in arresting the incipient paroxysm.[4] *Syncope* from debility, or from a strong nervous shock, is habitually relieved by ammonia applied to the nostrils, or swallowed. In this connection it is proper again to insist upon caution in using liquid ammonia for the purpose of recalling persons from a state of unconsciousness. Owing to its incautious use, the lips, nose, and eyes of patients have been violently inflamed, and even become gangrenous.

In *asphyxia* from drowning it has sometimes excited a renewal of the vital actions. It should not, however, be employed to the neglect of artificial breathing, heat, frictions, etc., nor persisted in so as to inflame the nostrils.

Poisoning by Hydrocyanic Acid, etc.—There is a difference of opinion in regard to the utility of ammonia in poisoning by *hydrocyanic acid.* Mitscherlich inclines to the opinion that its combination with this

[1] Bull. de Thérap., xxxiii. 159.
[2] Revue Méd., xciii. 172; Annuaire de Thérap., vi. 257.
[3] Pereira, The Elements, etc., 3d Am. ed., i. 432.
[4] De l'Epilepsie, p. 604.

acid does not lessen the effects of the poison.[1] Orfila says,[2] "It would be absurd to consider ammonia an antidote of prussic acid." Yet he admits that the *inspiration* of a slightly ammoniacal liquid may successfully rouse the system from such a degree of oppression as would otherwise prove fatal. But caustic ammonia, used either by inhalation or swallowed, he regards as augmenting the danger by its corrosive action. Christison, however, calls it "probably the best antidote for poisoning with hydrocyanic acid," and in this opinion Pereira concurs. Murray, of Edinburgh, was so convinced of its efficacy by experiments which he made on animals and on himself, that he did not hesitate to declare his willingness to swallow a poisonous dose of prussic acid if he could be certain of having ammonia at once administered to him.[3] Probably the stimulant effects of the ammonia upon the nervous system and the heart are the source of its efficacy, rather than its chemical combination with the poison; but of the latter there can be no reasonable doubt. It is in the former manner, doubtless, that its usefulness as an antidote to other narcotic poisons must be explained. It is a prompt and effectual antidote to *alcoholic intoxication*. The writer has seen a man who was taken from the gutter in a state of complete and helpless drunkenness, speedily restored to his senses and the use of his limbs by a few drops of water of ammonia, diluted and poured down his throat. A very similar instance occurred in the wards of Dupuytren at l'Hôtel Dieu,[4] and others are related by Piazza.[5]

A number of authors testify to the usefulness of ammonia as an antidote to the *poison of venomous reptiles and insects*, and even of rabid animals. Except the last, these forms of poisoning appear, to a certain extent, to be controlled or mitigated by ammonia. Certain it is that, when applied to the recent punctures made by *mosquitoes*, *bees*, *wasps*, *spiders*, etc., the pain and inflammation subside at once. Many examples of its successful use in poisoning from the bite of *vipers* are recorded by Jussieu, Rasori, Hufeland, Michon,[6] and others. It is proper to state that its efficacy has been denied by Fontana and by Gaspard, on the ground chiefly that the bite of these reptiles is seldom fatal. But such an explanation cannot be admitted in regard to the bites of the *rattlesnake* and the *moccasin*, and for these its efficacy seems to be established in a certain number of cases at least. Dr. Moore, of Mississippi, furnished valuable testimony upon this point.[7] He reported seventeen cases of poisoning by one or the other of these serpents which were cured by ammonia. Three of the cases, related at length, are not less surprising as proofs of the efficacy of the alkali than remarkable for the enormous doses of it taken by the patients. He administered not less than a fluidrachm at a time, in a wineglassful of cold water, and applied the solution also to the wound. The patients were

[1] Op. cit., ii. 281.
[2] Méd. Légale, i. 335.
[3] Eberle, Therapeutics, p. 403.
[4] Bull. de Thérap., vii. 131.
[5] Ibid., vii. 161.
[6] Ibid., xxxi. 70.
[7] Am. Journ. of the Med. Sci., i. 341.

all negroes. Their symptoms were alarming, but were mitigated directly the alkali was made use of. Dr. Heustis speaks of this medicine as being the popular domestic remedy in Alabama for the bite of rattlesnakes, and states that a teaspoonful of it in water is given every fifteen minutes until relief is obtained.[1] Inspector-General of Hospitals, Charles J. Smith, tried the effect of liquor ammoniæ upon dogs. Having procured some fresh cobras he caused the dogs to be bitten by them, when the animals were watched until the poison took effect. All the dogs to which ammonia was administered recovered, all which did not receive it died. On one occasion a snake charmer was bitten on the hand by a large cobra, and was apparently dying with the usual symptoms produced by the creature's bite. Liquid ammoniæ in half-drachm doses, and sufficiently diluted, was given every ten or fifteen minutes. Other remedies were employed, but the man's recovery was attributed to this one.[2] Mr. John Balfour relates two cases in which the administration of ammonia within five minutes after the infliction of bites by the East Indian cobra, appears to have saved life.[3] Prof. Halford, of Melbourne, Australia, has reported upon the use of ammonia by an entirely new method, which consists of injecting twenty or thirty minims of a solution of one part of strong solution of ammonia to two parts of distilled water into a vein by means of a hypodermic syringe. His experiments upon animals demonstrated conclusively the antidotal power of ammonia employed in this manner in regard to the poison of the tiger snake.[4] Subsequently numerous cases occurred to himself and other Australian practitioners in which the same method was followed by very prompt and remarkable relief of all the symptoms of snake poisoning, even when the condition of the patients appeared to be altogether desperate.[5] It may be mentioned that so high a value was set upon Prof. Halford's discovery by the practitioners and citizens of Melbourne, that a public acknowledgment of it was made in the form of a gift of one hundred and twenty sovereigns. Taking all of these facts into consideration it would seem that the verdict of the accomplished investigator of the "Venom of the Rattlesnake," Dr. S. W. Mitchell, is, perhaps, too unfavorable to the value of ammonia as an antidote, when he says: "The pretensions of ammonia have been long since settled by the experiments of Fontana on Vipers, and of Brainard on *Crotalophorus*. I have also tested its supposed utility in cases of animals poisoned by Crotalus venom, and add that it failed almost entirely."[6]

Ammonia has also been vaunted as an antidote to the effects of *poisonous mushrooms*, but Paulet has proved it to be injurious rather than salutary.[7]

[1] Am. Journ. of the Med. Sci., vi. 83.
[2] Brit. Med. Journ., Feb. 22, 1868.
[3] Edinb. Med. Journ., xvii. 416.
[4] Times and Gaz., Jan. 1869, p. 54.
[5] Times and Gaz., Jan. 1869, p. 123; Bull. de Thérap., lxxviii. 285.
[6] Researches upon the Venom of the Rattlesnake, 1861, p. 113.
[7] Orfila, Méd. Légale, ii. 680.

Administration.—The dose of aqua ammoniæ is from ten to thirty drops, largely diluted with water. The dose of spirit of ammonia is from ten to thirty drops, and of the aromatic spirit of ammonia from thirty drops to a fluidrachm, in a wineglassful of water.

When it is intended to produce vesication with either of the preparations of ammonia described in this article, it is only necessary to saturate some porous material with the liquid, and, having applied it to the skin, to cover it with an impermeable substance. When the surface to be irritated is large, a piece of cotton or woollen cloth and the bottom of a plate or tumbler are convenient means for the purpose; when small, as in vesication for the relief of neuralgia, a thimble, an egg-cup, or a watch-glass, with a pledget of lint or cotton-wool, may be employed. From three to ten minutes generally suffice to produce the desired effect. Gondret's paste may be formed into a disk of the size of a silver half-dollar or less, and with a spatula applied until a slight blush around its edges shows that the purpose is accomplished. Rubefaction with ammoniated liniments is best produced by gently rubbing them into the skin with a piece of flannel.

Antidotes.—Vinegar, lemon-juice, or any vegetable acid, may be used to neutralize whatever ammonia remains uncombined in the system; after which a moderate antiphlogistic treatment is necessary to palliate its secondary effects.

POTASSA.—Caustic Potassa.

Potassa cum Calce.—*Potassa with Lime.*

Liquor Potassæ.—*Solution of Potassa.*

Potassii Carbonas.—*Carbonate of Potassium.*

Potassii Carbonas Pura.—*Pure Carbonate of Potassium.*

History.—Potash seems to have been known in the pure and solid form as early as the thirteenth century, and in solution much earlier,[1] as appears from the description by Pliny of a soap made with tallow and ashes, of which he describes a hard and a soft variety, and which, according to him, was used to give the hair a light color.[2]

Description.—*Potassa* is obtained from a solution of carbonate of potassium by treating the latter with slaked lime, and evaporating. It is generally found in the shops as a *hydrate*, containing some impurities which give it a bluish or grayish color, and prevent its perfect solubility in water and in alcohol. But it

[1] Christison, Dispensatory. [2] Hist. Nat., xxviii. 51.

dissolves completely in either of these liquids when pure, and is then also of a white color. It absorbs water and carbonic acid rapidly from the air.

Carbonate of Potassium, as used in medicine, may be prepared from the impure salt which is known in commerce as pearlash (POTASSII CARBONAS IMPURA—*Impure Carbonate of Potassium*), and which is produced by the incineration of wood. It is procured officinally by evaporating a filtered solution of the impure carbonate. This salt is difficult of crystallization, and is generally met with in a granular state. It has a strong alkaline taste and reaction with chemical tests. It is white, inodorous, and has a remarkable affinity for water.

Pure Carbonate of Potassium is obtained by heating the bicarbonate to redness, dissolving in distilled water, filtering, and evaporating the solution.

Liquor Potassæ is a solution of potassa in water, procured by removing the carbonic acid of the bi-carbonate from a solution by means of lime. It is a clear, colorless, and inodorous liquid, with a very acrid taste. When rubbed between the fingers, it has a soapy feel, in consequence of its union with the fatty matters it there comes into contact with.

Action. *On Animals.*—Hertwig[1] injected five grains of caustic potassa, dissolved in a drachm of water, into the veins of a dog. Immediately the breathing grew labored, there were signs of great suffering followed by exhaustion, paralysis, suspension of the pulse, and death in the course of forty minutes. The same experimenter injected from twelve to twenty grains of potassa, with three ounces of water into the veins of a horse. The animal became rather more lively, and its warmth increased, the mucous membrane of the fauces became darker, the pulse was small and frequent, and the breathing labored; there was also gaping, stretching of the limbs, retroversion of the head, and a disposition to urinate. At the expiration of half an hour or more the animal seemed dull and weak, but in three or four hours was well again. According to Viborg's experiment, in which half a drachm of potassa, dissolved in two and a half drachms of water, was injected into the jugular vein of a horse, there was general excitement of the system; the pulse, breathing, and temperature were rendered more active and intense; the bowels were moved, and the animal seemed to hunger. In the course of an hour the pulse became quick and small, and the horse stretched himself in a singular manner, and turned his head towards his loins. Shortly afterwards he urinated copiously, and speedily recovered.

Experiments on dogs were early performed with this substance by Bretonneau.[2] Forty grains of it were injected into the stomach of the animal, and produced repeated vomiting of a frothy liquid, with bloody stools of an alkaline character. On the morrow the symptoms had subsided, but for a week the appetite was less than

[1] WIBMER, Wirkung, etc, iv. 304. [2] Archives Gén. de Méd., xiii. 373.

usual. After the lapse of this time sixty grains of the alkali were administered, and the same symptoms arose. Several weeks afterwards the animal was strangled, and the mucous and cellular coats of the greater curvature of the stomach were found to be entirely destroyed; the rest of the stomach, and the commencement of the small intestine, were inflamed. In Orfila's experiments on dogs very similar results were obtained, but the animals appeared to suffer more severely. This difference arose from the fact that Orfila at first merely introduced the caustic into the animal's mouth and throat, whereas, Bretonneau, and, in some later experiments, Orfila also, passed the poison into the stomach, through an appropriate tube, so that the fauces and œsophagus, in which the common sensibility is much greater than in the stomach, were not cauterized.

On Man.—In its solid state, pure potassa is the strongest of all caustics. When brought into contact with the living tissues, it neutralizes the free acids, and decomposes whatever ammoniacal salts may be present, causing the evolution of ammoniacal gas. It combines with fibrin and albumen, forming soluble compounds. Gelatin also is readily dissolved by it, and any phosphate of lime which may be present is deposited.[1] Hence potassa, and the alkalies generally, are of all corrosive poisons those which most frequently perforate the stomach when taken internally.

When allowed to remain in contact with the surface of the body, potassa occasions for several hours a deep, burning pain, and produces a moist, leathery, and blackish slough. It sooner or later separates at the edges, and is cast off, leaving a clean and healthy ulcer beneath. The period of its separation varies considerably, and depends upon the depth to which the life of the cutis has been destroyed. If the entire thickness of the integument is not involved, the separation of the slough may require several weeks. The surrounding inflammation is seldom severe or extensive, and the surface of the sore produced soon secretes well-conditioned pus. If used incautiously, this caustic may become mischievous. Buchner saw[2] gangrene and death produced by it in a case in which a quack had employed it to remove a wart. When the caustic action is *feeble* and the slough more imperfect, its separation is longer delayed, and the resulting ulcer is less active, its granulations being often large and loose.

The symptoms of *poisoning* by potassa are enumerated by Orfila as follows: An acrid, urinous, and caustic taste in the mouth, a burning sensation in the throat, nausea, vomiting of matters which are often bloody and have an alkaline reaction, copious alvine dejections, severe pain at the epigastrium, and excruciating colic, convulsions, delirium, a cold, clammy skin, and if the dose has been large, speedy death. Sometimes the caustic action of the poison upon the larynx produces suffocation; sometimes the digestive organs are the seat of the fatal disorder, and occasionally death takes place after the lapse, it may be, of several weeks, and appears

[1] Pereira, op. cit. [2] Wibmer, Arzneim. u. Gifte, iv. 305.

to depend upon injury of the organs by which the primary acts of digestion are performed. The patient wastes away from inability to assimilate nourishment and from diarrhœa, and he may, in addition, suffer from stricture of the œsophagus. The *lesions* produced by the corrosive action of potassa, in cases of acute poisoning by that substance, consist of softening, abrasion, or ulceration of the mucous membrane of the mouth, œsophagus, and stomach, and a dark color of these parts.[1]

In small or *medicinal doses* the action of liquor potassæ is that of an antacid, particularly if taken soon after meals.[2] It combines with hydrochloric or with lactic acid, and then, doubtless, passes into the circulation. If taken on an empty stomach, it probably enters the bloodvessels unchanged, and in from thirty to ninety minutes an increased flow of slightly acid urine occurs, which contains the whole of the potash taken. Soon afterwards the urine regains its original composition and acidity. When this, or indeed any alkali is used habitually, it tends to lessen the coagulability of the blood by diminishing the proportion of its fibrin. This circumstance has long been familiarly known, whatever explanation of it may have been given, for the older writers observed that the long-continued use of the medicine gave rise to a general cachectic condition, with paleness and puffiness of the skin, passive hemorrhages, and general emaciation, a state, in fact, that bore the closest analogy to scurvy, and very probably depended upon the same condition of the blood which exists in that disease. This solvent property of the medicine helps to explain its efficacy in moderating the tendency of the system to plastic exudations, and in promoting the absorption of those already formed. It also suggests a caution in prescribing it for numerous cases of lithiasis and gout, in which its temporary palliative influence may be more than counterbalanced by the permanent debility of the system which it is liable to induce.

Potassa is also supposed to exert a special influence upon glandular organs, increasing their activity; but this operation, which is real, like the similar one of mercury depends upon its power of diminishing the plasticity of the blood.

The action of *carbonate of potassa* is essentially the same as that of the diluted caustic solution just described, and of the alkalies generally. Like them, it is poisonous in large doses, and it produces effects similar to theirs. But in small doses, and appropriately diluted, it is less nauseous and less irritating to the digestive organs, and is, on this account, more suitable than caustic potash for internal administration.

Although Geiger had pointed out the fact that fixed caustic alkalies possess the power of destroying the narcotic properties of the active principles of several solanaceous plants, the full demon-

[1] As illustrations the following cases may be examined: Lond. Hosp. Rep., iv. 56; St. George's Hosp. Rep., iii. 233; Glasgow Med. Journ., Aug. 1867, p. 121; Archiv der Heilkunde, xiii. 213.

[2] PARKES, Brit. and For. Med.-Chir. Rev., Jan. 1853, p. 272.

stration of this power was furnished by Dr. A. B. Garrod,[1] who states the results of his experiments as follows: "1. Caustic fixed alkalies, such as exist in liquor potassæ or liquor sodæ, entirely destroy the activity of henbane, preventing its action on the pupil when topically applied, and its influence on the system when internally administered; and, combined with a proper amount of these alkalies, the largest doses of the preparations of henbane may be given without the production of any symptom. 2. The same influence is exerted by the fixed caustic alkalies upon belladonna and stramonium. 3. The carbonates and bicarbonates of soda produce no injurious effects upon the preparations of any of the three above named plants."

Remedial Employment. *As a Caustic.*—The caustic action of potassa has been much employed to promote the healing of *callous sores* and sinuses, and to destroy the fungous granulations which hinder the cicatrization of such ulcers. It was also used at one time to excite inflammation of the parts covering *hernial* apertures, and in this manner to produce a solid cicatrix capable of preventing the protrusion of the bowel. Granulations produced by *ingrowing nails* may be more effectually removed by caustic potassa than any other escharotic. It forms the best means of destroying hard *warts.* A weak solution of the alkali, or of its carbonate, is a useful stimulant for indolent *ulcers.* Caustic potassa has been used to destroy *chancres* in their origin, and by that means to prevent constitutional infection; but the method is more painful and probably not more effectual than that by lunar caustic. *Poisoned wounds*, such as those inflicted by venomous serpents and by rabid animals, have been treated by this caustic. It may be doubted whether the latter class of injuries derive any benefit from the treatment unless it is resorted to immediately after the infliction of the wound. Excision of the bitten part, followed by the application of a caustic to the bleeding surface, may perhaps be warranted when the bite is inflicted by a really hydrophobic animal, but milder remedies than either are more suitable to all other poisoned wounds.

It may be unnecessary at the present time, but perhaps not useless, to place on record a caution respecting the application of potassa cum calce to *ulcers of the neck of the uterus.* Retention or suppression of the menses, metritis, occlusion of the cervix uteri, eschars and permanent strictures of the vagina, and even perforation of its walls have been the result of its excessive action; nor is the employment of caustic potassa alone unattended by consequences of a similar nature, however mitigated they may be in degree.[2]

Absorption of the products of inflammation is often promoted by the use of caustic potassa, yet it may be doubted whether it is more effectual than blisters and other counter-irritants. Commencing suppuration in *paronychia* has frequently been arrested by such an application of the caustic as will produce a thin and superficial eschar over the seat of pain. Sometimes it is employed in prefer-

[1] Med.-Chir. Trans., xli. 53 and 61.

[2] Tilt, Lancet, June, 1861, p. 556.

ence to the knife for evacuating *scrofulous abscesses*. The proper conditions for its use are, according to Vogt, as follows: When the swelling is not large and distended, does not depend on a deep constitutional taint, and has not been of very long standing, and especially when the after-treatment is prudently conducted. The best surgeons, however, seem to have quite discarded this method. And, indeed, its advantages are the very reverse of apparent. In chronic or subacute inflammation of the large joints, the potential cautery has been much used as a counter-irritant and derivative, and especially in *coxalgia*. For this disease the issue was established behind the great trochanter. In 1805, Dr. Hartshorne, of Philadelphia, proposed to treat *ununited fractures* by applying the caustic alkali to the neighboring integuments. Cline applied it to the ends of the fractured bone, and Dr. J. Rhea Barton combined both of these methods in the same case, and with success.[1] It is well known that many quacks have used caustic preparations to destroy *cancerous tumors*, and sometimes a cure has followed the treatment. Trousseau has also employed the Vienna paste (*potassa cum calce*) for this purpose, but it is of inferior value to arsenious acid, and also to chloride of zinc. *Carbuncles*, which are always painful and tedious, were formerly divided by crucial incisions, and the cut surfaces were thoroughly cauterized with potassa. The Vienna caustic has been successfully employed in some cases of *erectile tumors*, and also to cause the obliteration of *varicose veins*, but is objectionable on account of its painfulness, tediousness, and uncertainty. In *traumatic tetanus*, caustic potassa has been used by several physicians to produce counter-irritation over the spinal column. Cases demonstrating its efficacy have been reported by Hartshorne,[2] Thomas, of Maryland, Lewis, of Pittsburg,[3] and others. It is true that an author of repute, Curling, denies[4] that counter-irritation can be of service unless the disease be inflammatory. But the fact that it *is* of service is well established, and is of more consequence than the question of the inflammatory nature of the disease, which is not settled.

As a mild irritant, the carbonate is superior to pure potassa, and was, at one time, almost universally preferred. It is now but seldom employed. It has been prescribed in baths for the relief of various spasmodic diseases, including *tetanus*, *puerperal convulsions*, *epilepsy*, etc.; for *paralysis* following apoplexy; for chronic *gouty*, *rheumatic* affections of the joints, chronic *glandular swellings*, *suppressed cutaneous eruptions*, etc. For the treatment of scaly and chronic vesicular eruptions of the skin, the salts of potash may be used, but soda and its preparations are generally preferred.

Internal Use. Gastric and Renal Diseases. Lithiasis.—The employment of alkalies in diseases of the urinary apparatus is not of recent date. The celebrated arcanum for *stone*, of Mrs. Stephens, which was purchased by the British Government for £5000, con-

[1] Am. Med. Recorder, ix. 275.
[2] Eclec. Report, vii. 245.
[3] Am. Med. Record., iii. 170.
[4] On Tetanus, p. 150.

sisted essentially of calcined egg-shells. Other secret remedies have turned out to consist of more or less strong preparations of wood ashes. That of Schenck was an impure carbonate of potassa (*sal absinthii*). Mascagni employed this salt as an antilithic in his own person. These empirical remedies led to the introduction into medicine of alkaline preparations in the treatment of *calculous disorders*, and a rationale of their action was constructed on chemical principles, according to which the medicine neutralized and rendered soluble the lithic acid of which so large a proportion of urinary concretions consists. But neither the empirical nor the so-called rational use of the medicine has answered fully to its first renown, and indeed it is now regarded by many physician as little more than a palliative. Employed with this view, potassa and its carbonates are unquestionably useful by suspending the formation of acid concretions in the urinary passages, as well as by neutralizing the excess of acid which is at the same time secreted in the stomach. But since this acid is the primary source of the evil, tonic medicines, and aromatic bitter infusions particularly, must be used to prevent its secretion, by giving tone and activity to the digestive organs. The gastric symptoms which call for the employment of alkaline medicines are principally heart-burn, sour eructations, aphthæ, spasm of the œsophagus, vomiting, cramp in the stomach, colic, and irregular diarrhœa. But it should not be forgotten that this treatment is palliative merely, and if too long continued must weaken the digestive powers and the whole system. Trousseau, indeed, remarks that the salutary effects of the medicine are not confined to the period during which it is taken, and insists that the alkalies are remedial by more than a chemical agency. So far as related to the benefits derived directly and exclusively from them, this position may be questioned. It is indeed true, that for months, or even years, after an attack of gravel, in which alkaline medicines were used, the calculous discharge may be suspended. But it is not uncommon for calculous deposits to cease from the urine spontaneously, and for a long time after an attack in which sand and gravel have been freely discharged. The whole calculous formation seems to have been gotten rid of, and that, perhaps, by means of a change already set up in the character or amount of the urine, so that without any specific treatment the disease appears to have been cured. Twenty minims of liquor potassa, largely diluted, are said to be an efficient means of preventing and also of relieving *strangury from cantharides.*

Inflammations.—Carbonate of potash, according to Richter,[1] holds out a promise of usefulness in those inflammations which tend to plastic exudation, and those especially which affect the lymphatic vessels and glands and the mucous and serous membranes. In these cases its operation, it has already been stated, is thought to be analogous to that of mercury. The appropriate period for its exhibition is said to be after the active symptoms have been reduced

[1] Ausfürlich, Arzneim., iii. 521.

by antiphlogistic measures, and when the products of inflammation show a tendency to permanence or to morbid degeneration. When taken for a long time it does undoubtedly diminish the plasticity of the blood, but that it can act thus with sufficient promptness to cure acute inflammations is more than doubtful. Yet upon this ground, and upon the further observation that concrete fibrin is soluble in caustic alkaline solutions, it would seem to have been recommended in *croup*. Nor is testimony in its favor wanting. Hellwag and Voos allege that it is often of very essential service in this disease; Dorfmüller cured cases in which, until it was used, there seemed no hope of recovery. Eggert regarded it as a specific for croup. But the testimony of these writers, and of others who report similar success, loses much of its weight when it is known that along with the alkali other remedies were employed of well-established power, such as mercurials, blistering, etc.[1] Hufeland advises this alkali not only in croup, but also in *pneumonia* and other inflammatory affections. Mascagni and Setürner testify to the same purpose. The method has nevertheless failed to obtain confidence, and is certainly inferior to depletion, and to mercurials, in the cases for which it is recommended. Perhaps, as some have suggested, it might form a useful associate to mercurial medicines. Potassa and its carbonates have been recommended in *whooping-cough*, but do not now enjoy any confidence.

Rheumatism.—In 1853 Dr. Fuller popularized the method of treating this disease by doses of alkalies large enough to neutralize the excessive acidity of the blood as it is manifested in the perspiration and urine. By this means he claimed to reduce the fever and the inflammatory symptoms, and above all to prevent those inflammatory complications of the heart, which form the most serious danger of acute articular rheumatism.[2] In 1868 Dr. Fuller, after fifteen years' experience of this method of treating acute articular rheumatism, could only confirm his original representations of its value. He was at first in the habit of prescribing thirty or forty grains of acetate of potash, and ninety grains of carbonate of soda dissolved in three or four ounces of water, and rendered effervescent by the addition of thirty or forty grains of citric acid, or of two or three tablespoonfuls of lemon-juice. The result of this combination was the administration of acetate of potash, and citrate of soda with about thirty grains of uncombined carbonate of soda. This dose repeated every four hours usually rendered the urine alkaline within twenty-four hours, but in severe cases it was necessary to give it every three hours. Subsequent experience led to the use of still larger doses, or, to quote Dr. Fuller's language, "An ounce and a half is the minimum dose of an alkaline carbonate which will suffice to overcome the acid condition of the system during the first twenty-four or forty-eight hours of treatment, and

[1] The efficacy in croup of atomized and vaporized lime-water tends to render more probable the statements in the text.

[2] On Rheumatism, etc. (Am. ed.), 1854, p. 95.

in sthenic cases two ounces are often needed. Four or five drachms, which form the maximum dose administered daily by many persons who imagine that they are using alkalies efficiently, are simply useless. They neither mitigate the pain nor shorten its duration, nor do they protect the heart from mischief." As soon as the urine is rendered alkaline, the draught is repeated every six hours only, and, if on the following day it still retains its alkalinity, the medicine is given twice only in twenty-four hours. As the tongue cleans the alkaline draught is withdrawn cautiously, and quinia given in its stead. This method, as has been demonstrated by Dr. Fuller himself, by Dr. Dickinson,[1] Mr. Robinson,[2] and others, not only abridges very materially the duration of the attack, but reduces almost to nothing the supreme danger of the disease, its cardiac complications.[3] No treatment whatever has proved so satisfactory in our hands, especially when to the internal administration of alkalies has been added the direct action of compresses saturated with an alkaline solution upon the inflamed joints. These fomentations should be applied warm, and kept in close contact with the skin by means of appropriate bandages. To prevent nausea and diarrhœa from the medicine, it should be given largely diluted, and in a state of effervescence, and only by day, while at night, at least after two or three days, its place should be supplied by Dover's powder or by opium, but not in too large doses, nor during the acuter periods of the attack, when the use of opium in full doses tends to maintain the acidity of the secretions, and to counteract the specific operation of the alkali.

Dropsy.—The diuretic powers of carbonate of potassa have already been alluded to. It would seem to be particularly applicable to those cases of dropsy in which the effusion results from suppressed perspiration, or from exposure to cold after scarlatina and other eruptive fevers; those, in a word, which are associated with a congested condition of the kidneys and obstruction of their canals. In the first-mentioned forms this medicine, like all the saline diuretics, has been found advantageous. Chapman mentions, as the cases in which carbonate of potash is most useful, those which are connected with great depravation of the digestive powers, and acidity of the stomach.

Scrofula.—Numerous writers testify to the usefulness of liquor potassæ in *scrofula.* Of these Brandish (1811) was one of the most noted. He administered the medicine in very large doses. For a child six or eight years old, he prescribed a drachm daily, and for adults three or four times that quantity. But the apparent efficacy of the medicine was undoubtedly due in a great degree to the nutritious diet and the hygienic measures employed at the same time. The form of scrofula in which he found it most effectual was the glandular, a form which, more than any other, is amenable to treatment. Dzondi employed the same method, and with such success,

[1] Med.-Chir. Trans., xlv. 349. [2] Lancet, June, 1869, p. 812.
[3] Fuller, St. George's Hosp. Rep., iii. 1; Practitioner, ii. 129.

it is said,[1] that often in from two to six weeks the swollen glands, the inflamed eyes, and the ulcerated skin, were cured. Sundelin regarded the usefulness of potash as most striking in scrofula affecting persons of a soft but full muscular system, and a torpid phlegmatic temperament. He prescribed a solution of one drachm of the alkali in an ounce of distilled water, of which two drops were given twice a day, to young children, and the dose gradually increased.[2] Pereira says: "I have seen the liquor potassa remarkably beneficial in excessive enlargement of the lenticular or glandular papillæ at the base of the tongue."

Frank prescribed the alkaline solution successfully in a case of excessive *tympanites*, probably of that sort which arises from an acid state of the secretions in the alimentary canal. Blane employed it in *dyspepsia*, accompanying a similar state of the digestive organs. Like magnesia and other antacids, bicarbonate of potassa has been found very serviceable in *dyspeptic vertigo*, a disease which is very apt to be mistaken for an affection of the brain, since its symptoms are more cerebral than gastric, *e. g.*, noises in the ears, giddiness, a sense of reeling, or swaying to and fro, etc. These symptoms are speedily removed by the medicines referred to, but the radical removal of the attacks will depend rather upon a proper dietetic treatment of the dyspepsia. Blane speaks[3] of the utility of alkalies in general in the treatment of eruptions of the face, and particularly in *gutta rosacea*, which is so apt to be associated with acid diatheses. He also refers to a remark of John Hunter, that the use of the caustic solution internally is a very effectual cure for *boils*. In other skin diseases this alkali is less commonly prescribed than soda. A review of all these therapeutic statements confirms the impression that the medicine derives its efficacy from its power of profoundly modifying the condition of the blood.

Administration.—Various preparations of potassa are employed as *caustics*. The most common is the hydrate of potassa, called *caustic potassa*; but *potassa cum calce*, or *Vienna caustic*, is less deliquescent and is also milder in its operation, and therefore more manageable. It is composed of equal parts of potassa and lime, and is preserved in the form of a powder, which must be made into a paste with alcohol before being used. One of the most convenient forms in which caustic potash can be employed is that devised by *Filhos*, and which is made by fusing together two parts of potassa and one of quicklime, and casting the liquid in cylindrical moulds. It is very hard and extremely powerful, and may be protected from the air by a suitable coat of varnish or of sealing-wax. To produce an eschar by means of either of these preparations, the part to be operated upon is covered with a piece of adhesive plaster in which an aperture is made of the size of the intended issue. A small piece of the solid caustic, or a portion of the paste, is laid upon the exposed part and allowed to remain, the former twelve hours, and the latter

[1] Richter, op. cit., iii. 500.
[2] Op. cit., i. 188.
[3] Dissertations, 203, 204.

from five to fifteen minutes. Or the part may be daily rubbed with the solid caustic, and, in the interval, be covered with a poultice. If the caustic spread beyond the intended limits, its action may be checked by vinegar and water.

The solution of potassa may be administered *internally* in doses of from ten minims to a fluidrachm, its effects being carefully watched meanwhile. It is recommended to be given in veal broth, or in table beer, but these vehicles are objectionable, the one by converting a portion of the medicine into soap, and the other, if sour, by neutralizing it. A sweetened aromatic infusion is preferable to either. This preparation should not be associated in prescriptions with henbane, belladonna, or stramonium, whose medicinal properties it destroys. No such effect is produced by the carbonate or the bicarbonate of potassium.

SODII CARBONAS.—Carbonate of Sodium.

Sodii Carbonas Exsiccata.—*Dried Carbonate of Sodium.*

Sodii Bicarbonas.—*Bicarbonate of Sodium.*

Description.—The carbonates of sodium now used in medicine are exclusively the products of chemical processes. The *carbonate* is obtained by adding sulphuric acid to sea salt, and decomposing the sulphate of sodium which results by means of ground chalk and small coal. This impure preparation is then lixiviated, and subsequently roasted in a reverberatory furnace, along with coal-dust or saw-dust. It is further purified by being redissolved and strained, after which the solution is allowed to crystallize by evaporation. The *dried-carbonate* is prepared by heating the *carbonate* in an iron vessel. The *bicarbonate* is prepared artificially by saturating a concentrated solution of the carbonate of sodium with carbonic acid. A partially pure or caustic *hydrate* of sodium (*Liquor Sodæ*) may be obtained by a method similar to that employed for caustic potassa. But the latter preparation is used to the exclusion of the former.

Carbonate of sodium is in the form of prismatic crystals, which are transparent, colorless, and have a strongly alkaline and even caustic taste. It contains nearly two-thirds of its weight of water. When heated, it dissolves with ebullition, and by exposure to the air rapidly effloresces. It is soluble in twice its weight of water, and, in dissolving, greatly reduces the temperature of the liquid. It is insoluble in alcohol. The bicarbonate of sodium is in the form of white powder or in small scales; it is almost tasteless, but has a somewhat alkaline savor. It does not change by exposure to the air, and is but slightly soluble in water, requiring thirteen parts of lukewarm water to effect its solution.

History.—The history of the native carbonates of sodium, known

to the ancients, is enveloped in much obscurity, for the qualities attributed to them by early writers do not clearly belong to these salts. The names of natron, natrum, and nitrum, are those by which the substances in question were known. The *natron* of the ancients is thought to have been a native mixture of the subcarbonate, muriate, and sometimes the sulphate of sodium,[1] and Pliny is supposed to have confounded under the name of *nitrum* the subcarbonate and the nitrate of potassium, and the subcarbonate of sodium.[2] The late Dr. Mitchell, of New York, mentions in his essays some facts which diminish the confusion of this subject.[3] According to him, the true oriental nitre was sodium, and was a native mineral alkali. In course of time it was found that the acid obtained from the incineration of the beech, oak, and other trees, might be employed instead of the original or native soda. Hence, potash came also to be called nitre, and when the combination of it with nitric acid was found in nature, that also received the name of nitre, which it still retains.

Pliny describes the several sources from which nitrum was obtained, as natural springs and lakes, the soil, and certain caves. It abounded especially in Egypt, where it was used in the process of embalming.

Carbonate of sodium exists in certain marine plants, of the genus *Salsola*, from which it may be obtained by incineration, but in an impure state. The sodas of Alicant, Carthagena, Malaga, and Sicily, furnish the largest proportion of pure alkali. The *sesquicarbonate* of sodium is found in solid, hard, striated masses near Tripoli, in Africa. The natives call it *trona*, a name which may probably be a corruption of *natron*. A soda of very nearly identical composition has been discovered near Merida, in South America. There is a native *subcarbonate* of sodium in Hungary and in Egypt, where it exists in the form of an efflorescence of fine, acicular crystals, mixed with chloride of sodium, and also in the mud of certain lakes.

According to Pliny,[4] in a chapter on sponges, the ashes of these bodies, which contain a large proportion of soda, may be usefully employed for granulations of the eyelids, for fleshy excrescences, and, in a word, for all cases that require detersive, fortifying, and stimulant applications. This author also speaks[5] of *nitrum* as caustic, astringent, and detersive, as useful in papular and pustular cutaneous eruptions, for repressing excessive perspiration, removing specks from the cornea, whitening the teeth, and destroying vermin on the skin; he prescribes it in an ointment for the bites of dogs, with vinegar and lime for the bites of serpents, and as a dressing for phagedenic and gangrenous ulcers. He also recommends a solution of it for correcting the unpleasant odor of the armpits, baths containing it for gout, for tetanic spasms, etc. Galen[6]

[1] Mérat and De Lens, Dict. cit., iv. 584.
[2] Ibid., vi. 394.
[3] Med. Repository, v. 119.
[4] Hist. Nat., xxxi. 47.
[5] Ibid., xxxi. 46.
[6] Ebn Baithar, op. cit., 188.

speaks of soda as being in daily use for the purposes of ablution—in baths, etc.—as well as for the cure of cutaneous affections. Dioscorides enumerates a great many cases besides those already mentioned, in which this substance is useful, but they are of questionable importance. Avicenna speaks of its use in eruptions of the scalp, and attributes to it vermifuge properties, as well as a tendency, when taken habitually, to weaken the digestion.

Action.—Many writers regard the medicinal qualities of the carbonates of sodium as so nearly identical with those of potassium, as to treat of them all under the same head. But there are real and important differences between them. The carbonates of sodium are less apt to derange the stomach, because, it may be, that they belong to the natural constituents of the body; on the other hand, the carbonates of potassium are more readily eliminated by the kidneys, and are, therefore, preferable when the action of the remedy is to be confined more particularly to the urinary organs.

Experiments performed by M. Grandeau appear to show that the action of the two salts in question may be very different indeed. He injected solutions of potassium salts and also of sodium salts into the veins of rabbits, and found that the former, even in very moderate doses, occasioned sudden death (not by asphyxia), and that the latter, even in considerable quantities, could be employed in the same way, not only without a fatal result, but even without any injury whatever. In this connection the author calls to mind the fact that while the red corpuscles of the blood are rich in potassium, the serum is equally so in soda in the form of chloride of sodium.[1] The precise bearing of these facts cannot at present be estimated; but they may very probably serve to explain some of the clinical differences in the operation of sodium and potassium salts.

Dr. Münch, the author of a very minute and elaborate essay upon the action of carbonate of sodium upon nutrition, arrives at the following, among other conclusions:[2] In general terms the operation of different doses is identical. At first, the secretions diminish and the body gains weight; subsequently, the former increase and the latter declines. The diminution of excretion affects chiefly the urine, but sometimes also the fæces and the perspiration; the latter especially when the dose is large. The increase of excretion is always indicated by that of the urine, and depends chiefly on the degree of its antecedent diminution. It relates almost exclusively to the watery element of the urine, and as the discharge progressively augments, the weight of the body diminishes in the same ratio. No influence whatever is exerted upon the nutrition of the solids. The urea, for example, is undiminished; but the uric and the free acids at first decline under the influence of soda, and may be reduced even to a mere trace; but the proportion of uric acid generally rises again in spite of the continued use of the medi-

[1] Journ. de l'Anat. et de la Physiol., No. 4, 1864.
[2] Archiv des Vereins für gemeinschaftliche Arbeiten, vi. 443.

cine. The free acids, however, disappear, and earthy phosphates take their place, and form sedimentary deposits.

Carbonate of sodium, in large doses, is irritant and corrosive, but by no means so much so as carbonate of potassium. As a poison it has no remote action, except what arises directly from the local injury inflicted. Its antidotes are fixed oils, vinegar, lemon-juice, or any preparation containing an excess of some vegetable acid, particularly the acetic, citric, and tartaric. In large doses it is diuretic, but less so than carbonate of potassium. Like that salt, it passes off by the kidneys, rendering the urine alkaline. "Some," says Dr. Christison, "have thought they observed injurious consequences from the long-continued use of alkaline carbonates in gravel and acidity of the stomach; and diseases of the kidneys, as well as organic disorders of the stomach, have been referred to the practice. These suppositions are probably imaginary. There can be no question that many have used alkaline remedies habitually throughout a long life, without injury." This statement is undoubtedly too absolute. The occasional deleterious results of a protracted use of alkalies have been pointed out under the head of *Potassa*, and are supported by the testimony of too many authors for us to call them in question.[1] But while insisting on the reality of the danger, it would be unfair to exaggerate it. The state of the economy has doubtless a determining influence upon the salutary or evil influence of alkaline remedies. As M. Mialhe has pointed out, the principal animal fluids are themselves alkaline in health, but, owing to certain habits of life, such as sedentary occupations and an animal diet among the inhabitants of towns, excretion is very imperfectly performed, and a great deal of acid which ought to be eliminated is retained within the system. Where these conditions, therefore, exist, a very large amount of alkaline ingesta is required to neutralize the retained acids; and, on the other hand, an active and laborious life, and a diet composed in greatest part of vegetable food, render the toleration of alkalies more difficult. In like manner diseases in which there is an excess of acid in the humors, such as gout, rheumatism, gravel, and diabetes, permit a very large amount of alkalies to be taken, not only with impunity, but with advantage, while the so-called "putrid" affections are uniformly aggravated by these medicines. In fact, if their mode of action be correctly understood, they would seem to be contraindicated in all cases of exhaustion and debility.

[1] Vid. TROUSSEAU (Journ. de Méd., 1846, p. 65); and BOUCHARDAT (Annuaire de Thérap., 1847, p. 120 et seq.), who gives a caution against the use of alkalies even for acidity of the stomach; for while he admits that their immediate benefits are certain, he at the same time insists that they expose the patient to serious risk by exciting an excessive secretion of the very acid they were destined to counteract. The same writer insists upon their operating as a cause of sudden death by augmenting the liquidity of the blood, and thus predisposing to apoplexy, or sometimes to engorgement of the lungs. He further states, that, having witnessed sudden death in two diabetic patients overdosed with alkalies, he believes that an abuse of the bicarbonate of soda had its share in the fatal result.

Remedial Employment. *Dyspepsia.*—In some forms of dyspepsia the most striking symptom is acidity of the primæ viæ. The conditions out of which they arise may be thus described.[1] The acidity in question may have its source in the acetous fermentation of amylaceous and saccharine food, the ingestion of sour substances, the development of carbonic acid gas in the bowels, an excessive formation of fatty acids resulting from the use of too much oleaginous food, and finally, a supersecretion of the normal acids of the stomach. Under all of these circumstances the carbonates of soda are especially indicated. The symptoms which are produced by an undue amount of acid in the stomach are not clearly determined, but the most certain are sour eructations, vomiting, and dejections, with heart-burn. Sometimes the tongue is thickly coated, but when the acidity is extreme, the tongue is clean, intensely red, and even shining, and very sensitive. The appetite is capricious, the mouth dry, and there is a sense of fulness at the præcordium. But gastric acidity is often connected with general disorder of the system, with anæmia, for example, and then, although soda may for a time correct it, the symptom speedily returns, and especially after the use of food containing starch or sugar. In this form of the complaint the use of alkalies, although it may for a time correct the acidity of the stomach, ultimately aggravates the evil, and still further impairs the constitution.

The form of dyspepsia which is connected with hypochondriasis sometimes finds relief in the use of soda, and especially in a full dose of the medicine taken directly after meals. In this affection the most prominent indication for the alkaline treatment is the occurrence of abdominal pain after eating. As soon as it has ceased the medicine should be suspended lest its general influence on the system prove injurious. In almost all cases in which alkalies are used for the purpose of neutralizing acids in the primæ viæ, the proper time for their administration is either during or after meals, for physiologists inform us that when the stomach is empty its secretions are but slightly acidulous.

Many ailments of young children arise from the ingestion of sour milk, or the generation of acid in the bowels. The little patients are restless, wakeful, and cross; they scream frequently, and especially after eating, their sleep is disturbed, they vomit curdled and sour milk, and by the retraction of the lower limbs show that they suffer from colic. In general the dejections are frequent, sour, and greenish, and consist of a thin liquid containing small fragments of yellow fæces resembling portions of hard-boiled eggs, or sometimes spinach and eggs finely hashed together. If the child is fed artificially, soda can be mixed with its food, or if it is still nursing, a solution of soda in some aromatic water may be administered, and in either case the addition of prepared chalk assists in moderating the diarrhœa. Trousseau states that at the Necker Hospital he succeeded in diminishing the rate of mortality among the young

[1] Kissel, Naturwiss. Thérap., p. 107.

children by adding about ten grains of bicarbonate of sodium to each quart of milk given them. This expedient has the further advantage of delaying for several hours the curdling of the milk intended to be used.

Lithiasis.—Soapmaker's lye was at one time extensively employed in calculous affections, and various secret remedies for such disorders have turned out to consist essentially of sodium in some of its combinations. The value of this alkali and its carbonates is chiefly shown in cases of lithic acid calculus and gravel. It is generally regarded as operative by means of its chemical affinities which are supposed to effect a solution of the concrete acid, but some have held that it is chiefly by promoting the flow of urine that it produces the discharge of sabulous concretions. No doubt that both modes of action contribute to the result. However this may be, it is certain that during the administration of soda the growth of acid concretions must be suspended, since the precipitation of their elements from the urine is prevented. So thoroughly, indeed, are the chemical conditions of this fluid changed, that from being acid it may become alkaline, and even deposit a coating of the latter nature upon the original calculus. Not a few writers testify to the complete cure of acid urinary concretions by means of soda, and some even maintain that these bodies may decrease in size, grow softer, and be discharged under its influence. This may unquestionably take place when the calculus is soft, or is composed of a congeries of particles held together by animal matter which is soluble in alkalies. A remedy of secret composition enjoyed considerable repute in the treatment of stone, some years ago in England. It was called "Constitution Water," and appeared to be essentially an alkaline solution. Dr. Golding Bird vouched for its success in cases of uric acid gravel, and stated that he was himself in the habit of using with very great advantage, in cases of pisiform uric acid gravel, a solution containing from two to four drachms bicarbonate of potassium dissolved in thirty or forty ounces of water, in the course of twenty-four hours. Mr. Bulley also reports a case of stone terminating, as it would seem, in perfect cure under the use of the carbonate of sodium.[1] One of the best forms for its administration is that of soda water, described below. The highly carbonated state of this liquid averts the danger of substituting alkaline for acid concretions in the urinary passages. Indeed, according to Christison, it exerts a curative influence in cases even of the phosphatic diathesis, by maintaining the earthy phosphates in solution.

Some writers will have it that the antilithic powers of soda are by no means exclusively confined to a neutralization of liquid or concreted acid in the system, but that it also prevents the morbid secretion of acid for a long time even after the medicine has ceased to be taken. Although, as has been elsewhere stated, the disappearance of acid concretions from the urine may be merely the sign

[1] Med. Times and Gazette, June, 1853, p. 600.

of a chemical solution of gravel retained in the urinary passages, or the effect of diuresis produced by the medicine, and not of such a change in the action of the system as arrests the production of gravel, it may nevertheless be possible that alkalies have a power of permanently suspending the calculous formation. But the evidence in favor of such a power is thus far incomplete.

It has been supposed, as already intimated, that soda is more acceptable to the stomach than potassa, for the reason that the former enters more largely than the latter into the composition of the animal economy. But it is by no means settled that the assertion on which this explanation rests is true in point of fact. Not a few writers maintain the contrary, and one of the most judicious, Blane,[1] uses this language: "As far as I can judge of the comparative powers of the two alkalies, I should greatly prefer potash to soda for the cases in question. One reason of this may perhaps be that soda is an element of the animal fluids, as it enters largely into the composition of the bile, so that it is more likely to be arrested in the course of the circulation, and diverted from the urinary organs."

Diabetes.—Dr. A. Clark, of New York, has reported several cases of saccharine diabetes in which bicarbonate of sodium entirely removed the sugar from the urine, reduced this excretion to its normal quantity, and renovated the general health. But in other cases it failed.[2] The most successful, however, was one which confirmed the results of observations made at Vichy, and other alkaline springs in Europe, viz., that obesity or a tendency to it is a strong indication that the waters will prove beneficial, while thin, pale, and nervous patients derive little or no advantage from their use.

Gout.—The use of soda and of alkaline remedies generally in chronic gout has been highly extolled by various writers. (*Vid.* Potassa.) The mineral waters of Vichy, in France, which contain a large proportion of soda, are perhaps the most renowned as a remedy for this disease. M. Rilliet, who examined the subject carefully,[3] concludes that these waters are a precious, if not a specific, remedy for gout, but he greatly weakens the value of this conclusion by the statement that thermal saline waters of all sorts have a similar efficacy.

Diseases of the Skin.—Alkaline medicines and baths were recommended by Willan and other English writers on cutaneous diseases. The latter form of administration, which has since been so extensively used upon the continent of Europe, was introduced into the Parisian hospital of St. Louis by Biett. In this country it is believed that there is no systematic employment of these and other methods for the cure of skin diseases in any of the large hospitals. The baths used by Biett were at a temperature of about 80° F., and each contained from four to sixteen ounces of carbonate of sodium. The patient remained in them for an hour.[4] By the use of such

[1] Dissertations, p. 188.
[2] New York Journ. of Med., Jan. 1859, p. 22.
[3] Archives Gén., Jan. 1844.
[4] Bull. de Thérap., vi. 296.

baths, if the skin is not inflamed, or is in a state only of chronic inflammation, it grows warmer, swells somewhat, and gradually its layers become more permeable, and resolution of the disease takes place. If the surfaces are red and inflamed, the alkali sometimes aggravates their irritation if its full action is allowed.[1] On this account, a much weaker solution than that used by Biett should be employed, and the action of the water may still further be tempered by the addition of mucilage, or of bran. Alkaline baths are found most efficient in the several forms of *lichen* and *prurigo*, and in dry *scaly* eruptions. Cazenave speaks of them as almost the only certain remedy for that form of prurigo to which children are subject, and which is so distressing in its effects, both upon body and mind. Indeed, the existence of itching is the prime indication for the use of these means. In *pustular* eruptions, and in tubercular *elephantiasis*, they would seem to be of inferior utility; but when in the former the crusts have grown thick and hard, and the inflammation of the skin is not active, they have a prompt and powerful effect. In *eczema*, alkaline baths are uniformly injurious if the eruption is in a state of activity and the solution strong; but when the inflammatory symptoms decline, baths of a weak solution of soda, in which bran is allowed to infuse, form one of the most soothing applications in this tormenting malady. The same method is highly useful when the skin has become thickened by successive eruptions of the disease.

When given internally, the effects of carbonate of sodium upon diseases of the skin are not at first very marked; yet in daily doses, of from two to four drachms, it generally produces a decided modification in the eruption. This at first consists merely of some alleviation of the itching, which gradually becomes less constant and severe. If the remedy is continued, an unusual heat is felt in the skin, in prurigo, for instance, and this often ushers in a more or less complete resolution of the inflammation. Cutaneous eruptions are not unfrequently connected with acidity of the primæ viæ, and when such is the case, soda is clearly indicated, whatever the state of the external disease may be.

It is claimed by Dr. C. Gerhardt that the inhalation of an atomized solution of bicarbonate of soda $\frac{1}{2}$ to $1\frac{1}{2}$ per cent. in strength repeated three or four times a day for a quarter of an hour at a time, is capable of removing *valvular obstructions from the heart*, in all cases of recent acute *endocarditis*, and of mitigating the symptoms in many cases of chronic valvular disease.[2] The method has much to recommend it, and would certainly be worth a trial when the recuperative powers of nature seem unable to proceed with the cure.

Alkaline lotions are very useful in cleansing portions of the skin upon which ointments have been applied, and the hairy scalp in particular. As a curative agent, also, for *herpes circinatus* of the thighs, in its declining stage, for *lichen agrius* of the calves of the

[1] Cazenave, Bull. de Thérap., iii. 109.
[2] Practitioner, ii. 119.

legs, for nummular lichen of the hands, and for *intertrigo* of the thighs, breasts, and armpits, these lotions have been recommended by Dévergie.[1]

Carbonate of sodium, in solution, may be employed to allay the itching of *pruritus of the vulva*, but is less effectual than the borate of soda, or than the bichloride of mercury.

A warm solution of carbonate of sodium (ʒj to ℥j) is recommended by Coesfield as an efficient means of softening *indurated cerumen*. A small quantity of the liquid should be retained in the auditory canal for ten or fifteen minutes while the patient lies in an appropriate posture. When this operation has been repeated twice daily for two days, the cerumen usually becomes soft enough to be easily dislodged by means of a syringe and warm water.[2]

Tumors.—Soda has been much employed as a resolvent for hypertrophied glandular organs, but, since the discovery of iodine, much less frequently than formerly. Peschier recommended it for *goitre*, and in *scrofula* it was found successful by Farre, Dzondi, Otto, and others. It is very probable that the soda employed by these writers was the variety obtained from the ashes of sea-weed, and that it contained a portion of iodine. Engorgement of the *liver* appears to be favorably influenced by soda when it arises from the malarious influences of warm climates, or from overfeeding, particularly if the affection is not of long standing. The waters of Vichy, in France, and of Schlangenbad, Karlsbad, and Ems, in Germany, are much resorted to for the relief of these affections.

Fevers.—The treatment of idiopathic continued fevers, by means of alkaline medicines, was brought into vogue, many years since, by Dr. Stevens, who advised them to be used in combination with salines, but, indeed, held them to be subordinate to the latter. Dr. Copland, in speaking of typhoid fevers, says that the carbonates of soda and of potash "are preferable in the latter and middle stages, more especially when the blood appears morbid, the skin discolored, and the excretions offensive." This treatment, however, does not appear to deserve much confidence. It is the offspring of a theory, and, like its parent, has now fallen into general discredit.

Rheumatism.—The use of lemon juice was introduced a few years ago into the treatment of rheumatism, as a mode of alkaline medication. Lemon juice contains citrate of potassium, but a much larger proportion of free acid. Indeed, the alkaline base is altogether inconsiderable. Although this salt and the acetate of potassium are perhaps more promptly effectual, the carbonates of sodium are superior to either of them in the treatment of acute rheumatism. But the alkaline treatment ought not to be used as a specific for rheumatism. It is of inestimable value in those febrile cases which are attended with copious lateritious deposits in the urine, and in which many joints are simultaneously involved, not only for its power of mitigating the pain and fever, but also, and

[1] Bull. de Thérap., xxix. 84.
[2] Med. Times and Gaz., July, 1867.

this is, indeed, its supreme value, for its influence in preventing cardiac complications (*vid.* Potassa); but it will not serve as a substitute for all other means, and especially it will not render unnecessary the use of opiates or of saline purgatives. Indeed, one of the most efficient forms in which alkalies can be administered in this affection is that of the potassium salts.

Administration and Dose.—Carbonate of sodium is given internally in solution. One of the best forms for its administration is that of soda water, or water strongly impregnated with carbonic acid, and holding in solution at least 40 grains of the salt to every pint of water. The dose of either carbonate of sodium is from 10 to 30 grains. Trousseau states the daily dose of the simple carbonate as from 30 grains to an ounce. Soda may be advantageously combined with tonics in many instances, and particularly with vegetable infusions of a stimulant and tonic character. But in all cases the solution should be very weak, for otherwise, the admixture of the soda with the saliva in the mouth tends to develop ammonia, and to excite a strong repugnance to the medicine. Soda lozenges (*Trochisci Sodæ Bicarbonatis*) are convenient and useful in cases of habitual acidity of the stomach. From two to eight ounces of the carbonate may be used in a general bath for diseases of the skin. A lotion, for the same purpose, should contain fifteen or twenty grains to the ounce of water for scaly affections, and about half that proportion for lichenoid eruptions. A solution of the latter strength is appropriate as a wash for the mucous membrane of the female genital organs.

SODII BORAS.—Borate of Sodium. Borax.

Description.—Native borax, known by the name of *Tinkal* (Tankâr), is extracted from the earth in Persia, China, Thibet, and Japan, or is gathered from the shores of certain lakes. It is also found in two mountainous districts near Potosi. From the waters of the lakes alluded to it is procured by artificial evaporation. As thus obtained, borax is in a very impure condition, being mixed with clay and a fatty substance which the alkali of the borax converts into soap. It is then of a bluish or yellowish color. The method of purifying borax was for a long time a secret of the Dutch and Venetians; but various processes were afterwards employed for this end, of which solution in hot water, exposure to heat, and mixture with soapsuds, were the principal. But in 1776 a new source of supply for borax was discovered in certain warm springs of Tuscany. The waters of these springs, which contain a large proportion of boracic acid evolved by volcanic agency, are artificially combined with soda by being mixed with the carbonate of this alkali.[1]

Borax is generally met with in the form of oblique prismatic or

[1] Sachs and Dulk, Handwört., i. 623.

octohedral crystals. When impure, they are small, opaque, of a greenish color, and a greasy feel; but when purified by repeated solution, they are large, white, semitransparent, and shining. Their taste is sweetish at first, but is afterwards alkaline and bitter. By friction together in the dark they become luminous. They effloresce slightly by continued exposure to the air. Borax has a feeble alkaline reaction, does not effervesce in acids, and, when exposed to a moderate heat, it parts rapidly with its water of crystallization, and swells up into a white porous and friable mass. At a higher temperature it is vitrified. It is soluble in twelve parts of cold and in two of warm water. Borax has the singular property of inspissating a solution of gum Arabic, of salep, or of Iceland moss. Even two or three grains of it are enough to convert half an ounce of gum mucilage into an elastic mass, which, however, may be liquefied again by the addition of honey or sugar to the mixture. When mixed with cream of tartar, it renders this salt more soluble.

History.—This substance is supposed to be described by Pliny under the name of *Chrysocolla.*[1] According to this author it is used as a vulnerary when mixed with wax and oil, and serves to dry and constringe wounds when applied to them in powder. It is used, he says, with honey for sore throat and for orthopnœa. It also acts as an emetic. It enters into collyria for removing opacities of the cornea, and into anodyne plasters and those intended to efface scars. Galen and Dioscorides ascribe to it virtues of the same kind. The Arabians, who named it *Tankâr*, also speak of its cleansing and astringent powers, and one of their number recommends it for toothache caused by caries.[2]

Action.—Owing to its therapeutical relations, borax may be classed with the alkalies, and especially with soda. From its effects when applied externally, it may be inferred to possess a local sedative influence upon morbid action in the nervous and vascular systems, which, however, it exerts, like many other agents, by previously stimulating the tissues to which it is applied. When taken internally, it does not disturb the digestion as much as the alkalies do. Wibmer took six drachms of it at a dose without any ill consequences beyond a temporary oppression at the stomach.[3] It is said to have a tendency to dissolve the blood and augment the secretions without exciting the circulation. According to Wibmer, the emmenagogue virtues of borax were known to the ancients, and, as will be seen in the sequel, modern observation is not wholly at variance with their belief. Vogt[4] speaks of its being particularly celebrated for these qualities, and not only for promoting menstruation, but also for moderating the cramp-like pains which often attend this process when it is irregular, for regulating the uterine contractions during labor, and for strengthening them when feeble. Some writers have not hesitated to ascribe such virtues to borax

[1] Hist. Nat., xxxiii. 28.
[2] Ebn Baithar, Heil- und Nahrungsmittel, i. 214.
[3] Wirkung der Arzneim. u. Gifte, v. 51.
[4] Pharmakodynamik, ii. 587.

upon no other ground than because the administration of this medicine in conjunction with *ergot* was followed by uterine contractions! According to Vogt, narcotic powers have also been ascribed to it.

Uses. *Externally.*—Borax has been much employed as a *cosmetic.* It is asserted to have the power of removing freckles and other accidental discolorations of the *skin.*[1] Hufeland recommends a wash composed as follows: ℞.—Sodæ borat. ʒss; aq. flor. aurant., aquæ rosæ, āā ℥ss, as one of the surest and at the same time most innocuous remedies for liver marks (*chloasma*), and those exanthematous spots which afflict young women of a plethoric habit, particularly at the menstrual periods. The discolored skin should be bathed three or four times a day with the solution, which should be allowed to remain upon it until it is dry. The same method is also recommended for that unseemly redness of the nose which proceeds from a similar cause. *Chilblains* are said to be relieved by a salve containing two drachms of borax to an ounce of cold cream. A wash composed of one drachm of borax in two ounces of distilled vinegar has been recommended by Abercrombie and by Christison as an excellent lotion for *ringworm of the scalp.* It has also, according to Pereira, been found serviceable in *pityriasis versicolor*, and Richter used a solution of it with advantage for removing *opacities of the cornea.* It is often employed in ill-conditioned *ulcers* of the skin and mucous membranes. When first applied it occasions a moderate sense of burning, but it quickens the reparative processes, cleanses foul and flabby surfaces and causes them to granulate. Although borax has no power of controlling mercurial *salivation*, it is nevertheless a most excellent agent for healing the ulcers which this state induces, and for strengthening spongy gums. For this purpose it is well to associate it with tincture of myrrh, as in the following formula: ℞.—Sodii bor. ʒij; aq. rosæ ℥vij; mel despumat., tr. myrrhæ, āā ℥ss.—M.

One of the most ordinary uses of borax is to remove the *aphthæ* which affect the mouth, fauces, and anus of nursing-children, and which appear to be caused by an undue generation of acid the result of the fermentation of the food in the primæ viæ. The medicine may be administered internally in doses of from three to ten grains a day, according to the child's age, and associated with magnesia in some aromatic solution, while the mouth is frequently coated with a paste composed of honey and borax, or of the latter with honey of roses or with a thick solution of gum Arabic and sugar.[2] Dewees prescribed, as the best agent for the purpose he had ever tried, equal parts of borax and loaf-sugar rubbed to a fine powder, of which a small quantity, in its dry state, was directed to be thrown into the mouth every two or three hours.[3] The latter is a more stimulating application than those previously mentioned, and should not, therefore, be preferred when the parts are extremely sensitive.

[1] Richter, Ausfür. Arzneim., iii. 558. [2] Richter, loc. cit.
[3] Dis. of Children, p. 309.

Honey of Borate of Sodium (MEL SODII BORATIS) is made by mixing 60 grains of borate of soda with a troyounce of clarified honey. *Glycerite of Borate of Sodium* (GLYCERITUM SODII BORATIS) is made by dissolving two troyounces of borate of sodium in half a pint of glycerin. Both preparations may be used in most of the cases mentioned.

An aphthous condition of the mucous membrane of the *vulva* and *vagina*, and which sometimes is a source of extreme annoyance and suffering, may almost certainly be cured by a watery solution of borax. Excoriations of these parts are healed by the same means, as well as superficial ulcers of the mouth and fauces, spongy gums, *fissures of the nipples*, etc. For the latter Richter recommends the following: ℞.—Sodæ bor. gr. lx; alb. et vitell. ovi, āā gr. cxx a gr. clxxx; ol. amyg. ℥j; bals. Peruv. gr. xc.—M. S.—Apply to the nipple on charpie.

Internally.—Richter regards it as indubitable that borax possesses a power of stimulating the *inert uterus*, exciting its secretion, and promoting its contractions during labor, and consequently that it deserves to be ranked with *emmenagogues*. Wedel, Stark, Lentin, Hufeland, Lobstein, and others, about the close of the last century, recalled attention to this almost forgotten property of the medicine. According to them, it is indicated in scanty and suppressed menstruation connected with plethora and a morbidly sensitive condition of the nervous system. The dose they employed was ten or fifteen grains three times a day. Wibmer[1] vouches for the reality of this virtue, and states that he gave to a female, whose menses were regular but scanty, a drachm of borax in sweetened water. During the night she was seized with severe cramps in the lower belly, and the discharge came on several days before its proper time, but was not more abundant than before. Dr. Stahl, of Vincennes, Ind.,[2] highly extols the efficacy of borax in the treatment of *dysmenorrhœa*, particularly in persons of a sanguine constitution. But the venesection and cooling laxatives he employed conjointly with the borax, deprive the latter of much credit for the result. Many authors have recommended it as an *ecbolic*. How far its power has been deduced from observation may be inferred from the statement already made above, and from that of Kopp, who asserts that when labor-pains slacken, four or six grain doses of borax, given every quarter or half hour, will often arouse the expulsive efforts of the uterus, and terminate the delivery. Sundelin, however,[3] testifies, upon the ground of his personal experience, to the efficacy of the medicine in terminating difficult and irregular labors. Dr. Golding Bird says, "In women this drug cannot be used with impunity, as it certainly exerts a stimulant action on the uterus, and I have seen it in two instances produce abortion."[4] A case is reported by Dr. Thorn,[5] in which premature labor is stated to have been brought

[1] Wirkung, etc., loc. sup. cit.
[2] Am. Jour. of Med. Sci., xx. 536.
[3] Heilmittellehre, i. 194.
[4] Urinary Deposits, § 164.
[5] Lancet, Aug. 1860, p. 134.

on by the administration of thirty grains of borate of sodium three times a day for sixteen days. The labor was natural, and the child was born alive. Similar testimony is furnished by Spengler; and Poitevin succeeded by its aid in arresting serious *menorrhagia*, which ergot and astringents had failed to suspend. He prescribed it in doses of fifteen grains repeated every hour or two until half an ounce had been taken.[1] In spite of these testimonials, few of the current publications upon the diseases of women recognize the virtues which are here ascribed, and as we believe, correctly, to borax.

Borax has also been used as a *lithontriptic*. It renders the urine alkaline, and is said to dissolve lithic acid gravel and calculi.

Administration.—The dose of borax, when given internally, varies from a few grains to a drachm.

CALX.—LIME.

AQUA CALCIS.—*Lime-Water.*

CALCII CARBONAS PRÆCIPITATA.—*Precipitated Carbonate of Calcium.*

CRETA PRÆPARATA.—*Prepared Chalk.*

Forms and Properties.—The medicinal properties of these several forms of lime are so nearly alike that they may be advantageously considered together.

Lime is never found pure in nature. It occurs, however, in combination with a variety of acids in all three of the kingdoms of nature. It is prepared by calcining, with a strong heat, some form of the native carbonate. As thus obtained, it is a grayish-white solid, which readily disintegrates on exposure to the air by absorbing carbonic acid and water. It is very refractory in the fire, and was first fused by the compound blowpipe of Dr. Hare.[2] It has a strong caustic and alkaline taste, and, when moistened, a peculiar odor. Upon adding to it about half its weight of water, it cracks and falls into powder with the evolution of heat enough to inflame sulphur. A larger proportion of water reduces it to a paste or mortar, which, by the evaporation of the liquid, grows exceedingly hard; a still larger proportion forms the solution known as lime-water.

Liquor Calcis, or Lime-water.—A striking peculiarity of lime is that it dissolves in cold more readily than in hot water. At 60° F. this liquid dissolves one seven-hundredth of its weight of lime, but hot water takes up only one twelve or thirteen-hundredth part of lime. Hence, when lime-water is heated it becomes clouded, and a deposit of lime takes place. It is a perfectly clear and trans-

[1] Bull. de Thérap., liii. 472.

[2] U. S. Dispensatory.

parent liquid, inodorous, and has an astringent and somewhat alkaline taste. It changes vegetable blues to green, and produces an imperfect soap with oils. A pellicle of carbonate of calcium forms upon its surface when it is exposed to the air, which afterwards subsides, and a new one takes its place. Thus by degrees the whole of the lime in the solution is exhausted.

Carbonates of Calcium.—One of the most common is *chalk*, which, as a native carbonate, exists in great abundance in the South of England and in the North of France, as well as in many other countries of Europe. The microscope shows it to consist of the shell-cases of marine insects. It is used in chemistry and pharmacy, but not in medicine until it has undergone the process of levigation and elutriation. It is then called *prepared chalk* (*Creta præparata*). Other medicinal varieties of carbonate of calcium are derived from the animal kingdom. These are: 1. *Testa præparata*, *prepared oyster-shell*, which, although obtained by calcination, contains a variable proportion of animal matter. 2. *Lapides Cancrorum*, or *Oculi Cancrorum* (*crabs' stones*, or *crabs' eyes*). These are small calcareous concretions formed in the stomach of the crawfish (*Astacus fluviatilis*) at the time when the animal is about to change its shell. They are smooth and button-shaped, with a depression in the middle of the concave surface, surrounded by a ring, which gives them some likeness to an eye, and suggests their popular name. They also contain some animal matter and phosphate of lime. In this country they can rarely be had genuine. 3. *Chelæ Cancrorum*, or *crabs' claws*, a preparation made by grinding the claws of *Cancer pagurus*. 4. *Corallia* (*corals*), red and white. The last two varieties are now obsolete in medicine, although coral is still used to make a dentifrice, for which purpose also carbonate of calcium obtained by precipitation is employed.

Medical History.—Hippocrates recommended milk of lime or lime-water as a remedy for leprous affections.[1] Dioscorides describes three varieties of lime, one made from sea-shells, another from certain pebbles, and a third, which he says is the best of all, from marble. He mentions its hot nature, and its use as an escharotic, and also that when mixed with fat or oil it is maturative, emollient, resolutive, and healing. Galen describes it in the same terms, and adds that it loses its caustic quality in some degree by exposure to the air, and altogether by the addition of water, but continues to be powerfully desiccative.[2] Pliny gives a similar description, adding that, when mixed with vinegar and honey of roses, lime promotes the healing of serpiginous ulcers.[3] The ancients were acquainted only with the external use of lime-water, and employed it for various sores and eruptions, and particularly for burns; until introduced into practical medicine by Lower, in the seventeenth century, it was never administered internally. Its first application was to the treatment of calculous disorders, and soon

[1] Ed. Van der Linden, i. 708. [2] MATTHIOLI Comment., v. 91.
[3] Lib. xxxvi. 67.

afterwards to that of scrofula, dropsy, chronic ulcers, fistulæ, cutaneous eruptions, diabetes, and various other affections;[1] but this enumeration is sufficient to prove that it has not yet lost all of its original repute. In 1808, Sir H. Davy proved lime to be the oxide of a metallic base, to which he gave the name of calcium.

Action.—*Quicklime* (*Calx viva*), or unslaked lime, produces a rapid decomposition and destruction of organized matter. In this manner it serves as a valuable manure, causing the solution of all vegetable and animal matters in the soil. Hence it is habitually used to purify cesspools, dissecting-rooms, etc., is placed in graves when it is desirable to destroy the dead body rapidly, and on a large scale it is employed on battle-fields. Tanners make use of it to separate the hair and cuticle from skins. In its local action, quicklime resembles the pure alkalies, but is less energetic, owing, probably, to its inferior affinity for moisture. It is caustic, however, when taken internally and in large doses, occasioning vesicular inflammation of the mouth and fauces, heat, pain, and inflammation of the stomach, and sometimes ulceration and gangrene of that organ and of the œsophagus, with fever, thirst, bloody stools, extreme anguish, and even death.[2]

Lime-water differs from the solutions of the alkalies in being destitute of caustic properties. On the other hand, it has a powerful astringent and styptic operation. Hence, even in overdoses, it never disorganizes the animal tissues. Its astringency is not shown by a contraction of the parts to which it is applied; it appears rather to control their secernent action, rendering them dry and pale. Even Dioscorides noticed this drying quality of the medicine, which has also been designated in the same manner by Vogt and other modern authorities. When absorbed, lime-water has a similar effect upon the glandular organs, diminishing their secretions in a remarkable degree. Its habitual use is therefore apt to be hurtful as well by neutralizing the acids of the primæ viæ as by arresting their habitual mucous secretion. A number of writers, particularly of the German schools, agree in attributing to lime-water a resolvent action like that of iodine upon enlarged glands, but they appear to have borrowed the statement from some common authority rather than from actual experience. Since, however, the free acids of the stomach must to some extent convert the lime of this liquid into soluble salts which are absorbed, the alleged effects cannot be explicitly denied. According to Vogt,[3] lime-water exerts a sedative influence upon the nervous system, besides acting as a desiccant, and is therefore analogous in its action to the preparations of zinc.

Carbonates of Calcium.—The action of the mineral carbonates does not differ from that of lime-water. Prepared crabs' eyes, egg-shells, oyster-shells, and other testaceous products, contain a certain pro-

[1] Detharding, Halleri Disputationes, vii. 258.
[2] Wibmer, Wirkung, etc., ii. 5; Orfila, Toxicologie, i. 204.
[3] Lehrbuch, etc., ii. 503.

portion of animal matter, and on that account are less astringent than the mineral carbonates of calcium. In small doses, therefore, they may be used with less inconvenience than the latter; but when administered largely, and for a long time, they entail the same disorder of the digestive organs.

Richter, in noticing the general substitution which has been made of mineral for animal preparations of lime, expresses an opinion that it was an error to do so, and he calls attention to the fact that the ancients regarded corals as tonic, pearls as diaphoretic and as antidotes in poisoning, etc. Prepared chalk, he remarks, is by no means a substitute for cretaceous preparations derived from the animal kingdom, which are more acceptable to the stomach in moderate doses, constipate less, and are more readily absorbed into the system. This writer ascribes a diaphoretic virtue to *crabs' eyes*, alleges that they may produce urticaria, and that they tend to excite hemorrhage. The latter qualities may perhaps be hypothetical; but the belief that the animal carbonates in general, derange the stomach less than other cretaceous medicines, and are on that account preferable to the mineral carbonates for infants and delicate persons generally, cannot, it is believed, be successfully controverted.

Remedial Employment. *Externally.*—*Quicklime* is a very powerful escharotic. Mixed with sulphuret of arsenic, it has sometimes been used to destroy indolent and unhealthy *ulcers*, but more frequently as a *depilatory*. For the latter purpose the orientals are said to apply it to the pudendum, etc., and in Europe it is sometimes employed to remove superfluous hairs from the upper lip and from the bosom of females. When a mixture of two parts of lime with three of water is saturated with sulphuretted hydrogen, a greenish-white jelly is formed, which may be used for the purpose just mentioned by spreading it upon the skin for two or three minutes, and then removing it with an ivory knife. The operation is said to be entirely effectual, without producing the slightest pain, or in any wise injuring the skin.[1] Quicklime has also been used to remove *congenital nævi*. In this case it is mixed with an equal quantity of soap, and applied to the tumor through an opening made in a piece of adhesive plaster, accurately adjusted. The resulting slough separates, and the ulcer which it leaves behind is dressed with some stimulating ointment. It may also be used to establish *issues* in the same manner, or after that recommended by Mr. Osborne. This consists in placing a small fragment of freshly-prepared lime upon the skin, after protecting the adjacent parts in the manner described. A few drops of water are then added. The heat produced is estimated at 350° F., and so rapidly destroys the organization of the skin that the lime ought to be removed before it is entirely exhausted, in order to prevent too deep an eschar. The officinal caustic, *Potassa cum Calce*, is less energetic, but may be used for the same purpose.

[1] Trousseau and Pidoux, Thérapeutique, i. 360.

Lime-water is often serviceable in pustular *eruptions of the skin* when they have assumed the chronic form. In *tinea capitis* it has been highly recommended. The scalp should first be cleansed, as far as possible, with soap and water, and the lotion applied to it with a soft brush. In all forms of foul and unhealthy *ulcers*, lime-water is of use both to diminish the discharge and to excite a more wholesome action of the tissues. It also answers an excellent purpose in modifying the condition of the *mucous membrane* of the fauces, auditory canal, vagina, urethra, or rectum, when any one of these passages is the seat of a chronic, mucous, or purulent discharge. The accumulated secretions should first be removed by injections or washes of water or soap and water. It may be effectually employed to destroy *ascarides* of the rectum. In a case in which these parasites invaded the vagina, causing extreme distress, Richter procured entire relief by its means. Sir Robert Boyle mentions lime-water and sweet oil, the present *linimentum calcis*, as an excellent remedy for *burns*.[1] Indeed, it was employed by the Greek and Roman physicians for the same purposes,[2] and is now in general use. It is most appropriate in superficial burns, without destruction of the skin. Dr. Joseph Bell, of Glasgow, recommends against *pitting in smallpox* the application of cotton wadding saturated with this liniment, so as to form a firm mask for the face.[3]

The combination of lime-water with calomel forms the well-known and useful *black wash*, and its union with corrosive sublimate, the *yellow wash*, concerning both of which more will be said under the head of *Mercury*.

Prepared chalk, finely pulverized, is often used as a *dusting powder* by females who have a coarse and greasy skin, as well as to promote the healing of *abrasions* of the integument, slight *burns* and *scalds*, *erythematous eruptions*, etc. An ointment prepared with chalk is serviceable in *ulcers* with loose granulations and a profuse discharge.

Internally. Pulmonary Affections.—Several writers attribute decidedly curative effects to *lime-water* in *chronic bronchitis*, with profuse expectoration. If the medicine is absorbed, and actually carried to the anatomical seat of the disease, its curative effects agree with those it exhibits when directly applied to secreting surfaces. In these affections atomized lime-water may be inhaled with advantage. Even in cases of cavities in the lungs, with copious discharge, it lessens the secretion. But, except when the bowels are already the seat of a morbid exhalation, the astringent operation of the medicine upon them may perhaps outweigh its advantage to the lungs, and it should therefore be carefully associated with correctives of its binding quality.

Pseudomembranous Laryngitis.—In this affection, as well as in *pseudomembranous pharyngitis*, that is to say, in true croup and in diphtheria, lime-water has been successfully employed on the suggestion of Küchenmeister's experiment, in which this liquid was shown to

[1] Works, SHAW's ed., iii. 581. [2] VOGT, i. 595.
[3] Glasgow Med. Journ., July, 1861.

act as a prompt solvent of false membranes immersed in it. Dr. Förster found that on immersing in lime-water, not only fresh pharyngeal or laryngeal false membrane, but that which had been for several months in alcohol, the membrane softened and disintegrated in from five to ten minutes, leaving a detritus which, under the microscope, was found to be composed of cells and nuclei. Whence it was evident that the liquid acted by dissolving the fibrinous constituent of the exudation.[1] M. Biermer, of Berne, in 1865, treated a case, the true nature of which was proved by the rejection of false membranes, by means of warm atomized lime-water. Although the patient appeared to be in extreme peril, he soon obtained relief from this measure, and finally recovered. Küchenmeister published a case of pharyngo-laryngitis with false membrane, in which he, also, was successful, and Brauser another one of similar character.[2] Dr. H. E. Schmid, of White Plains, N. Y., was, we believe, the next person to publish an account of the success of this remedy, which, as in the other instances, was applied by means of an atomizer, and appeared to save life under the most desperate circumstances.[3] Other communications have appeared in medical journals which purport to contain examples of the efficacy of this treatment: but since they do not furnish the only criterion by which catarrhal can be distinguished from pseudo-membranous laryngitis, the actual rejection of false membranes, they do not illustrate the present subject, although they may be regarded as showing that the vapor or spray of lime-water may be useful even in catarrhal laryngitis of a grave type. Perhaps this statement may be still further qualified, and it may be contended that both in simple laryngitis and in the croupous form of the disease the inhalations in question owe their efficacy to the moisture of the vapor and not to the lime it holds in solution. For, as Förster has pointed out, the quantity of lime-water that can reach the larynx or trachea must be incomparably smaller than the amount used in the experiments on its solvent power above related, too small, therefore, in all probability to produce the supposed effect; and the time during which its action can be maintained is very much less than the shortest period necessary for developing its solvent power in the test-glass. Moreover, a large proportion of the lime suspended in the watery-vapor that is inhaled must be converted into a carbonate by meeting the expired air, and thereby rendered to that extent inert.

Vomiting.—Lime-water is one of the most useful remedies for excessive vomiting, especially when it is administered with an equal quantity of milk, or of cinnamon water. The particular forms of vomiting it is adapted to relieve are not very clearly ascertained, but it may perhaps be said in general to be most successful when there is least inflammation and fever, and when the rejected matters are unusually acid. In certain cases of chronic vomiting, which

[1] Arch. der Heilkunde, v. 522.
[2] Bull. de Thérap., lxviii. 323.
[3] The Med. Record, ii. 78.

are independent of cancerous disease of the stomach, but due sometimes to simple ulcer, the first combination referred to affords an admirable means of nourishing the patient, while it suspends and sometimes even cures the disease.

Diarrhœa.—The various combinations of *chalk* with aromatics, opiates, and astringents, are among the most useful and widely-known remedies for diarrhœa. The cases to which these preparations are adapted, and those which are more profitably treated by purgatives, are not, it is true, discriminated thoroughly, but it may perhaps be laid down as a rule that the former are indicated by signs of gastro-intestinal acidity. Thus, sour eructations, tormina, tympanitic distension of the abdomen, acid discharges, and, in children, greenish stools, are so many signs for the employment of cretaceous medicines. Yet, even here, except in the heats of midsummer, and in the cases of very young or feeble persons, a laxative ought to precede the use of the astringent medicine. In the premonitory diarrhœa of epidemic *cholera* no better medicine can be administered than the ordinary chalk mixture with laudanum and tincture of kino or catechu.

Lime-water is very suitable for the forms of chronic diarrhœa connected with a feeble condition of the alimentary canal. When ulceration exists, it is more apt to be mischievous than useful, except in those cases of chronic dysentery in which the febrile movement and pain have both terminated. Blane testifies to the eminent usefulness of lime-water "in chronic dysenteries of the lienteric kind."[1] In such cases a diet composed almost exclusively of milk and lime-water, in nearly equal proportions, produces the most beneficial results, and often suffices to complete the cure, as we have seen in numerous cases of the disease among soldiers. Lesser speaks of the successful use of lime-water and milk in arresting the *diarrhœa* of *typhoid fever*, when it continues too long and too copiously, and we also are able to testify to its utility.

In *tympanitis* and *flatulent colic* arising from habitual acidity of the primæ viæ, the astringent and alkaline qualities of lime-water are extremely useful in removing the cause of these distressing symptoms in children, and in moderating its influence in adults. With the latter the disorder is a form of dyspepsia, and requires for its cure a strictly regulated diet, and also the association with the lime-water of vegetable tonics and alteratives, such as columbo and dandelion, and occasionally rhubarb and soap to keep the bowels free.

Dewees found great advantage from lime-water and milk in cases of infantile *aphthæ* with green but not liquid stools. He directed a teaspoonful of the mixture to be given four or five times a day.[2] In such cases, when diarrhœa takes place, prepared chalk is preferable to lime-water.

Stone and Gravel.—In 1739 the British Parliament decreed a national recompense of five thousand pounds sterling, to Mrs. Jo-

[1] Dissertations, p. 203.

[2] Diseases of Children, p. 308.

anna Stephens for her lithontriptic remedy, which consisted of calcined egg-shells, soap, and several aromatic bitters. This preparation, however, was found so nauseous and so distressing to the stomach, that various substitutes were proposed for it, of which the most simple was *lime-water*. This was suggested by Whytt.[1] He observed that quicklime had long been looked upon by chemists as containing a powerful remedy against calculus, and he mentioned that the very combination employed by Mrs. Stephens had been commended by Barbette as of incomparable use in all suppressions of the urine from stone and gravel. Whytt gave several instances of its efficacy, one of which was the celebrated Horace Walpole. The sufferings of this statesman were entirely removed by the remedy, although after his death, which was not caused by calculous disorders, several small stones and fragments of others were found in his bladder.[2] In like manner calculi were found after death in the bladder of each of the four persons whose cure by Mrs. Stephens' remedy had been officially attested, and which prompted the grant of money already alluded to.[3] Alston may be cited in favor of the efficacy of this liquid in calculous affections. "I found it," he says, "*Dei gratia*, by my own experience, a cure for stone in the bladder, which diminished so much that it passed without pain." Soap, containing a large proportion of alkali, was one ingredient of the Stephens nostrum, so that the antilithic powers of the latter ought not to be attributed entirely to lime.

It cannot be doubted that much of the reputation acquired by lime-water, as a remedy for stone in the bladder, depends upon its astringent quality, by which it allays the inflammatory condition, and blunts the sensibility of this organ. The writings of Gaitshell, Blane, and Whytt attest the benefits of its use, but the explanation now offered appears to be confirmed by the testimony of Whytt himself, who found the remedy most effectual when it was directly injected into the bladder. Butter also employed this method, which he described in a published essay, and regarded as very successful. He directed the patient to be placed so that his buttocks should be raised, and, after having first thrown mucilage into the bladder, injected the lime-water twice a day, gradually increasing the quantity. At the same time he administered the medicine by the mouth.[4]

What the operation of lime-water in stone may be is not very clearly made out. But it seems to be determined that this liquid has not the degree of solvent power which its original advocates so strongly insisted upon. As already remarked, it more probably renders the mucous membrane of the bladder insensible to the irritation of the stone, and, if judiciously managed, prevents the growth of the calculus by neutralizing the free acid of the urine.

[1] Edinb. Med. Ess. and Obs., 3d ed., v. 2d pt. p. 156.
[2] Commentar. Lipsienses, ix. 681.
[3] Alston's Lectures on the Mat. Med., i. 268.
[4] Comment. Lipsienses, iv. 273.

The latter mode of action has been suggested by Blane[1] and others. Urate of lime is said to be more soluble than uric acid or urate of ammonia (*Christison*); but the reverse is also stated (*Thudicum*). It is alleged[2] that lime-water is only suitable to chronic forms of calculous disease, when the patient is free from fever, the bladder indolent, etc. But however just this restriction of its use may be, there can be no doubt that it is a remedy too much neglected at the present time as a palliative for stone, and that, like many other medicines, it has lost credit because it was incapable of performing all that was promised in its name. There is some reason to believe that uric acid gravel may be dissolved and eliminated under its use. How far it may be superior to the carbonates of the alkalies for this purpose, will depend chiefly on the state of the digestive organs. When these are feeble, lime-water is the better preparation.

Chronic *purulent discharges* from the urinary passages are often favorably modified by this remedy, particulary when it is associated with astringent diuretics, as uva ursi, etc. It may also be used by injection.

In *diabetes insipidus*, and even in the *mellitic* form of diabetes, this medicine is said to have been curative. Two cases of the latter are given by Kissel.[3] In them it was not until after several weeks' use of the remedy that the discharge of urine began to diminish; but the subsequent progress towards cure was rapid.

Whytt claimed to have cured *chronic gout* in almost every instance by the use of lime-water.[4] In the dyspepsia of gouty subjects it is also useful. Clarus[5] declares the utility of lime-water in cases of *rachitis* and *osteomalacia*, maintaining that it directly furnishes the deficient element. Without positive proof of his proposition, he cites the analogous example of the effect of excluding lime from the food of poultry. The eggs produced by them are unfurnished with a shell. Hence it is inferred that the calcareous element of human bones may be supplied artificially when it is deficient.

Many writers allude to the efficacy of lime-water as an internal remedy for *cutaneous affections*, such as gutta rosacea, or those impetiginous affections which depend upon hereditary constitution, or which are connected with calculous or scorbutic complaints. Blane says that he has seen some remarkable cures of herpetic complaints of the legs by large doses of lime-water, not less than three pints a day. Hoffman also states that he obtained excellent results from the use of lime-water and milk in *scurvy* produced by salt provisions.[6]

When *arsenic*, in a liquid form, has been administered in a poisonous dose, lime-water forms with it an innocuous compound. "In the absence of more appropriate antidotes, lime-water may be administered in poisoning by common mineral and oxalic acids."

[1] Dissertations, p. 200.
[2] Mérat and De Lens, Dict., ii. 24.
[3] Naturwissenschaft. Therapie, p. 221.
[4] Ed. Med. and Phys. Ess., iii. 459.
[5] Arzneimittellehre, p. 132.
[6] De Scorbuto.

Administration and Dose.—The dose of *lime-water* is from *half an ounce to six ounces*, given from one to four times a day with an equal quantity of milk, or in weak broth.

The dose of *precipitated carbonate of calcium*, *of prepared chalk*, or of the animal cretaceous preparations, is from *five* to 120 *grains*. It should be suspended in water by the intervention of gum Arabic and sugar.

LITHII CARBONAS.—Carbonate of Lithium.

Lithii Citras.—*Citrate of Lithium.*

Description and History.—Lithia was first discovered by Arfwedson in 1817, in the mineral Petalite, and was so named from λιθειος, stone-like, because it was supposed to exist in the mineral kingdom only. It has been extracted from several other minerals, and has been found in many mineral springs, as those of Carlsbad, Aix-la-Chapelle, Baden-Baden, Marienbad, Kissingen, Ems, Teplitz, Kreuznach, Vichy, etc., in Europe, and the Gettysburg Spring in the United States. Indeed, it is shown by spectrum analysis to be one of the most widely diffused substances in nature. For commercial purposes it is chiefly obtained from the mineral lepidolite, a kind of mica which oocurs in the granite of Bohemia. The metal lithium is exceedingly light, having a less specific gravity than any liquid. Its oxide, lithia, in the form of a hydrate, is white and transparent, soluble in water, sparingly so in alcohol, and has an acrid alkaline taste and reaction. The equivalent number of the metal lithium is 7, the lowest combining number of any of the fixed alkalies, hence its saturating power exceeds theirs in the same proportion. Fifteen parts of lithia will saturate as much acid as 41 parts of soda or 47 of potassa. The carbonate of lithium, consisting of one equivalent of each constituent (LO,CO_2), is a white powder of a mild alkaline taste, like that of bicarbonate of sodium, is soluble in one hundred parts of water (or about 4 grains in ℥j), and is nearly insoluble in alcohol. Carbonic acid in water increases the solvent power of the liquid materially. The citrate, which is also officinal, is freely soluble. The carbonate of lithia was first suggested as a solvent for uric acid by Mr. Ure, in 1843. His experiments were followed by those of Dr. Garrod, on whose recommendation it was used as a medicine.

Action.—Mr. Ure found that a calculus composed of uric acid and oxalate of lime lost sensibly in weight when suspended in a warm solution of carbonate of lithia; and Dr. Garrod states that when a portion of the end of a metacarpal bone infiltrated with gouty concretions was placed in a solution of carbonate of lithium, in two or three days no deposit could be seen and the cartilage appeared to be restored to its normal state. Hence it was assumed that in gouty subjects the carbonate and other soluble salts of

lithium would prevent the formation of gouty concretions and dissolve them when they had been formed.

Uses.—Dr. Garrod states that having made many trials of carbonate of lithium as an internal remedy, both in cases of *uric acid diathesis* connected with gravel and in cases of *chronic gout*, he found that in doses of from one to four grains dissolved in water, and repeated two or three times a day, it produces no direct physiological symptom, but exerts a marked influence in cases when patients are voiding uric acid gravel, causing the formation of the deposits to become less or cease altogether. In many instances the frequency of the attacks of gout was diminished, and the condition of the patients improved.[1] These statements did not fail to attract attention and cause the medicine to be everywhere employed, and, had they been confirmed, would have presented a striking illustration and proof of the value of a scientific prevision of a therapeutic effect. But although gout and gravel are among the most common diseases, especially in Europe, it is impossible to find any trustworthy confirmation of their accuracy. On the contrary, the evidence is either negative or adverse. Dr. Habershon, for example, speaking of gouty dyspepsia, remarks, "I have tried the salts of lithia in these cases, but without the benefit expected from the laudatory terms of its introducer;"[2] and Dr. Peter Hood in his "Treatise on Gout, etc." (1871), did not even allude to it. Prof. Ditterich, of Munich, indeed, claims that it has fallen into disrepute because it was unsuitably administered, that it is appropriate only in chronic gout, that the dose of the carbonate should not exceed two grains three times a day, and that relief from it is not to be expected in less time than from eight to fifteen days.[3] These objections do not appear to us to invalidate the general verdict.

It is claimed, as we have seen, that the efficacy of certain mineral waters in gout may be due to the lithium which they contain. To give substance to such an argument in favor of the virtues of lithium it must first be shown, that the ingredient in question possesses those powers. To conclude that lithium is a specific for gout or gravel on the strength of its existing as a minutely fractional proportion in certain waters reputed to cure these affections, is as if one were to prove the nutritive properties of common salt by pointing out those of the bread which it seasons. Some twelve or thirteen years ago (in 1860) Prof. Bunsen made an analysis of certain springs at Baden-Baden, and detected in them chloride of lithium in the proportion of from one-fifth of a grain to a little more than two grains in a pint of the water. Thenceforth they began to work remarkable cures of gout.[4] But a few years earlier a well known writer on the mineral waters of Europe remarked, of those of Baden-Baden, "that they are extremely complaisant, for they possess exactly the virtues they are desired to have."[5]

[1] The Nature and Treatment of Gout (1859), p. 438.
[2] Diseases of the Stomach (1866), p. 167. [3] Practitioner, viii. 312.
[4] ALTHAUS, Times and Gaz., Nov. 1861, p. 527.
[5] Guide Pratique, etc., par C. JAMES, 4ème éd., p. 274.

Dr. Förster, of Dresden, has called attention to the solvent power which a solution of carbonate of lithium exerts upon *false membrane* immersed in it. In this respect he finds that it stands next to lime-water, and suggests that it might, like that liquid, be employed in the treatment of psudo-membranous affections.[1]

Administration.—Carbonate of lithium may be administered in doses of from *one to five grains* three times a day, dissolved in not less than four ounces of water, or preferably of carbonated water. The dose of the citrate is somewhat larger.

POTASSII PERMANGANAS.—Permanganate of Potassium.

Preparation.—This salt is obtained by mixing together chlorate of potash and oxide of manganese, adding to the mixture a solution of caustic potash, and evaporating to dryness. The mass thus formed is then pulverized and exposed to a red heat until semi-fused. When cool it is pulverized, dissolved again in boiling distilled water, and evaporated until a pellicle begins to form upon the surface of the solution. It is then set aside to cool and crystallize.

Description.—As thus prepared, permanganate of potassium forms slender prismatic or acicular crystals of a dark purple color, and having a sweetish astringent taste. It is readily soluble in water.

A small crystal of the salt is sufficient to color an ounce of water deep purple. It is decolorized by a solution of arseniate of potassium, and by acidulated sulphate of iron. It readily yields its oxygen to bodies having an affinity for that element, and especially to all organic matters, including sugar, glycerin, and alcohol.

Action.—The property last mentioned accounts for the great utility of this salt in medicine as a deodorizing agent, and for limiting putrefaction. For these purposes it was first introduced by Mr. Condy, in 1857. He proposed by its means to determine the presence of and to neutralize impurities in the atmosphere, and in drinking water, to arrest decomposition in tainted meat, etc. It is generally described as a deodorant, an escharotic, and a stimulant; but the second of these qualities it does not possess except in a very slight degree; nor, indeed, at all, unless it is applied to a raw surface in a concentrated solution or in powder. Upon mucous surfaces it causes neither pain nor irritation.[2]

Sicard asserts that the addition of this substance to a putrescible mass, as pus, for example, prevents its putrefaction; but Cosmao-Dumenez and Demarquay found that the putrefactive process was not prevented in portions of liver and lung, immersed in a concentrated solution of the salt.[3] It would appear that although it does not hinder the decomposition of animal matter, it has the power

[1] Archiv. der Heilkunde, vi. 521.
[2] Bull. de Thér., lxix. 437.
[3] Ibid.

of seizing upon the products of decomposition in the nascent state, and combining with them, or oxidizing them, so as to prevent the usual effects of such emanations, and among them the disengagement of offensive smells. Very minute quantities of the permanganate, such as solutions containing but one or two grains to the ounce, are sufficient to produce this effect. The deoxidation of the solution is shown by its losing its violet color, and becoming dull red, which indicates the formation of sesquioxide of manganese.

Uses.—This substance is chiefly and very usefully employed in destroying the fœtor of certain ulcers and suppurating surfaces. As early as 1857 Dr. Girdwood published[1] a number of cases, including *cancer*, unhealthy corroding *ulcers*, *caries* of the tibia, and *gangrene*, in which it not only removed the fœtor entirely, but exerted a vivifying influence upon the affected tissues, so that their cure, where that was possible, appeared to be greatly promoted. Its beneficial influence is strikingly exemplified in cases of open cancer, of one case of which disease it is said the remedy "occasioned the wound, from a gaping sore in a most offensive condition, to assume, in some parts, a disposition to granulate." In open cancer of the uterus and of the breast, it greatly mitigates the distress of the patient occasioned by the insufferable fœtor arising from these lesions, and to that extent, at least, renders life more tolerable. But for this purpose frequently repeated applications are necessary, in the case of uterine cancer by means of injections, and in that disease of the mamma by pledgets of lint saturated with a solution of appropriate strength. The same effect is produced upon *gangrenous sores* of other parts; and in this respect the permanganate is incomparably superior to the preparations of chlorine on account of its being free from odor itself, and to poultices of charcoal, yeast, carrot, etc., from its more convenient mode of application. In all cases of external *ulcers* requiring its use, it may be applied by pencilling with a strong solution of the salt, by pledgets of lint saturated with a weaker preparation, or by the spray from a hand or steam atomizer. In *ozæna* nothing can exceed the comfort produced by the proper application of this medicine, which should be either by a spray producer, or still better, by a solution introduced into one nostril and allowed to run out by the other, while the patient breathes with the mouth open after the manner so ingeniously suggested and employed by Dr. Thudicum. The fetid discharge in *otorrhœa* is changed in its quality and gradually arrested by injections containing the permanganate of potassium, or by pledgets of wool saturated with its solution of appropriate strength. A case is reported in which a fetid nasal catarrh extended to the cavity of the upper jaw bone, necessitating the extraction of a molar tooth to give exit to the pus. This secretion, however, continued and retained a disgusting taste and fœtor until the antrum was washed out with a solution of the permanganate, one part in ten. A complete and permanent cure was effected.[2] In the proportion of about three

[1] Lancet, Sept. 1857, p. 269. [2] Bull. de Thér. lxxv. 332.

grains to the ounce of water it forms an excellent mouth-wash and gargle when *foul breath* arises from carious teeth or from the secretions of the faucial follicles. It is the best palliative for the repulsive odor exhaled by the *feet* or by the *armpits* of certain persons; and is superior to all other applications for removing the offensive and persistent smell from the hands of persons engaged in making *dissections*. A solution of the permanganate has been much employed for the cure of *leucorrhœa* and of *gonorrhœa*. In the latter disease an injection is used, three or four times a day, of a solution of from one to ten grains of the salt in an ounce of pure water. In the former affection it is equally efficient, if regularly employed, and may be used in a much stronger solution than in the former case. In diminishing the amount and correcting the fœtor of the *lochial discharge* nothing is more successful than this salt.

Permanganate of potassium has been but little used as an internal remedy. Dr. Mackall, however, reports that during an epidemic of *diphtheria* he was induced, by the failure of chloride of iron and of chlorate of potassa to cure the disease, to employ the permanganate. He applied to the fauces a wash made by dissolving sixty grains of the salt in a pint of water, and gave internally, every three hours, a teaspoonful of a solution containing the same quantity of the salt in a pint and a half of water.[1] His observations led him to believe that the medicine both prevented the formation of false membrane and promoted its separation when formed. Dr. I. Kay, of Springfield, O., is persuaded that he cured many cases of *epidemic meningitis* with this medicine in hourly doses of half a grain;[2] but as these doses were alternated with an equal quantity of opium, it must be considered very doubtful whether any part of the benefit resulted from the antiseptic medicine. Further trials of it in the treatment of zymotic diseases ought certainly to be made.

One of the most useful applications of this substance is to the *purification of water* from organic matter. By adding a solution of the permanganate drop by drop to water containing such matter, it gradually deprives the water of its offensive taste and smell by oxidizing its organic contents, and is itself deprived of its characteristic color. But as soon as the oxidation is completed, the pink tinge of the solution remains unchanged, and then after standing for a time the water may be used without danger. To insure the disinfection the pink color should be perceptible after the water has stood for twenty-four hours, and may be accelerated by heating the liquid.

The stains produced by permanganate of potassium may be removed by a weak solution of sulphurous acid, of sulphate of iron, or of muriatic acid in water. The action of these reagents, and especially of the two latter, is, however, less prompt and complete than that of cyanide of potassium in the case of nitrate of silver stains.

Application.—It is convenient to have at hand a solution of

[1] Am. Journ. of Med. Sci., Jan. 1865, p. 87.
[2] Boston Med. and Surg. Journ., June, 1864, p. 373.

known strength which can be diluted still further, as occasion may require. Some persons recommend one part of the salt dissolved in ninety-nine by weight of distilled water; but as this is too feeble for certain purposes, a solution of one part to nine is to be preferred. By the addition of distilled or pure water it can easily be reduced to the required strength. It has been found that a solution of two grains to the fluidounce is most appropriate for vaginal and urethral injections, and as a wash for simple wounds and ulcers; a solution of twice that strength is sufficient for correcting the fœtor of discharges from the same parts; and one of eight grains to the ounce is appropriate for disinfecting fæcal discharges, surgical dressings, etc. It should not be associated with sugar in solution, as it is thereby deoxidized and rendered inert.

SODII SULPHIS.—Sulphite of Sodium.

Potassii Sulphis.—*Sulphite of Potassium.*

Acidum Sulphurosum.—*Sulphurous Acid.*

Preparation.—Sulphite of Sodium is prepared by passing sulphurous acid into a solution of carbonate of sodium, and evaporating out of contact with the air. It consists of one equivalent each of sodium and sulphurous acid and three equivalents of water (NaO,SO_2+3HO). According to some authorities it contains ten equivalents of water. It forms white prismatic crystals, which effloresce on exposure to the air, while oxygen is absorbed, changing the salt into sulphate of sodium. It is readily soluble in cold and in hot water, and has a saline and sulphurous taste. The sulphite of potassium is prepared with a sulphurous acid and a solution of carbonate of potassium, in the manner just described for the sulphite of sodium. It is in white opaque fragments or powder, and is very soluble in water. It decrepitates when heated, and effloresces in the air.

These are the only officinal sulphites. But others may be obtained which possess essentially the same medicinal qualities, *e. g.*, the bisulphite and hyposulphite of sodium, the sulphites and hyposulphites of magnesium and of lime.

Action.—Although the power possessed by the sulphites of controlling fermentation had long been known and usefully employed, it was not generally recognized or applied in medicine until attention was attracted to the subject by the experiments of Dr. Polli, of Milan.[1] Assuming as correct the hypothesis that the phenomena of contagious and infectious diseases are due to a process of zymosis, or fermentation, and recognizing the power of sulphurous acid to check fermentation and putrefaction, he concluded that this acid or its salts must be capable of curing radically the diseases in

[1] Dublin Quart. Journ., May, 1862, p. 367.

question. By experiment he found that the fatal symptoms occasioned by the introduction of putrid substances into the veins of animals were modified, suspended, or neutralized by the injection of solutions of the sulphites into the blood. It was also demonstrated that gangrenous and fetid suppurating surfaces, and all foul-smelling discharges were speedily rendered inodorous by the application of these salts in solution. But the clinical proof of their efficacy in disease, which would have gone far to justify the hypothesis of Polli, was not at that time adduced by him, nor has it yet been conclusively furnished.

It may be of interest to know that, according to the experiments of Mr. M. C. Lea, the sulphites when taken internally appear for a time to be entirely oxidized in the system, but that when their administration is continued, they are, or their excess is, discharged undecomposed with the urine.[1] Semmola, also, concluded from his experiments that "the normal processes of oxidation proceed without being interfered with by the sulphites, and that the daily excretion of urea, carbonic acid, and water remains unchanged during their use."

Uses.—Chaussier and Biett, and after them Quesneville, in France,[2] made use of the hyposulphite of sodium both internally and externally for the cure of *diseases of the skin;* and Graham, Neale, and Dobie, in Great Britain, recommended it for the cure of fermentative *dyspepsia*, but others have found all of the alkaline sulphites inferior, in this respect, to sulphurous acid itself. Dr. Lawson[3] includes under the term *pyrosis*, not only the purely functional disorder so named, but also cases of gastric catarrh, ulcer, cancer, and those irritable conditions of the stomach associated with unhealthy menstruation, in which a thick, glairy, opalescent, semi-mucous, sour liquid is with greater or less frequency ejected. He found that the acid checked excessive secretion, stopped vomiting, and lessened epigastric pain; and he believed its efficacy to depend upon its power of arresting fermentation and the production of sarcinæ and torulæ, leptothrix, vibriones, and bacteria. Dr. L. gave the acid before meals in doses varying from thirty to sixty minims in plain water. A further evidence of the power of this remedy over low organizations is furnished by the remarkable facility with which it cures *sycosis menti*, which is in part, at least, due to the presence of a parasitic plant, named mentagrophyton. A solution of forty grains of sulphite of sodium in an ounce of water should be frequently applied to the affected part.[4] Dr. C. M. Watson claims that he cured the analogous disease, *scalled head*, by the application of a solution of sulphite of sodium used at first of the strength of half an ounce to the pint, and afterwards of half that strength. He found it equally successful in the treatment of *impetigo faciei* or *crusta lactea*.[5] Dr. Roe, of Dublin, has administered the bisulphite of

[1] Am. Journ. of Med. Sci., Jan. 1865, p. 84.
[2] Abeille Méd., 1845, p. 151.
[3] Practitioner, i. 169.
[4] Am. Journ. of Med. Sci., Jan. 1866, p. 281; July, 1866, p. 276.
[5] Am. Journ. of Med. Sci., Oct. 1869, p. 586.

sodium successfully as a vermicide in cases of *lumbricoid ascarides.*[1] It is a useful application in *pruritus pudendi*, and is said not only to soothe the irritation of the skin in *smallpox*, which is possible, but also to ameliorate the disease and shorten its duration, which is highly improbable. In *sphilitic* ulcers of the throat an atomized solution of sulphurous acid has been found efficient. The hypothesis respecting the nature of blood diseases, and the power of the sulphites in arresting their development, which has already been referred to, stimulated several clinical observers to study the effects of these medicines. De Renzi considered that a *phthisical* patient took twenty grains of the sulphite of sodium three times a day with manifest advantage. At least one physician has claimed to cure *diabetes* by means of the sulphite of sodium,[2] but the cases published in support of the claim appear to prove a great deal too much.

In *erysipelas* Capparelli, of Naples, gave 120 grains of hyposulphite of soda in solution, every twenty-four hours. In one case, of the traumatic variety, the patient recovered; in the other, which was idiopathic, the patient died.[3] Drs. Fisher and Davis, of Chicago, present a very favorable judgment of the efficacy of the sulphites in this disease. The latter refers to ten cases of the most severe grade of epidemic erysipelas, marked by typhoid symptoms, and four of them complicated with diarrhœa, all of which recovered under the use of sulphite of lime in drachm doses, given every two hours.[4] Dr. A. Hewson has also reported very positively in favor of the sulphites as an external application where the skin is alone involved. A solution of ten grains of sulphite of soda in an ounce of water applied on lint so as to extend beyond the inflamed surface, and kept covered with oiled silk, is represented as producing a decided bleaching effect on the discolored surface within the first twenty-four hours of its use, and as destroying all traces of the disease within forty-eight hours. The result was the same, whether the attack was idiopathic or traumatic, in all of twenty-seven cases in which it was tried.[5]

These observations are apparently so conclusive in regard to the value of the sulphites in erysipelas, that the paucity of published testimony in their favor cannot but excite surprise, and they suggest the suspicion that other physicians than those referred to have not found the remedies as efficient as they are here represented to have been. For our own part, having treated a large number of cases of idiopathic erysipelas, by a treatment in the main expectant, and without ever having seen it terminate fatally, we cannot refrain from entertaining some incredulity in regard to the efficacy of a remedy which has not been established by positive proofs.

Intermittent Fevers.—Attention was first called to the use of alkaline sulphites in malarial fevers by Dr. Polli, referred to above, and the results of his experiments may be summarized as follows:

[1] Practitioner, ii. 239.
[2] Philada. Med. Times, i. 356.
[3] Paul, loc. cit.
[4] Trans. Am. Med. Assoc., 1865, p. 110.
[5] Am. Journ. of the Med. Sci., July, 1865, p. 95.

"1. Marsh fever can be cured by the sulphites alone. 2. The action of the sulphites on the attack of fever is less rapid than that of the sulphate of quinia; they do not so suddenly stop the periodical course of the fever, but they usually diminish the violence of the symptoms till they disappear altogether. 3. The sulphites act more certainly in preventing the return of the fever than quinine. Among 403 cases treated by the sulphites relapses occurred only in 5.7 per cent., while in 183 cases treated with sulphate of quinine, the relapses amounted to 44.5 per cent. 4. Many cases of miasmatic fever long rebellious under quinine, were cured by the sulphites alone. 5. The sulphites can be employed with success even as a prophylactic means, and they may be used for long periods without danger, which is not the case with quinine. 6. The sulphites can be administered without danger in spite of the concomitant gastro-intestinal irritation, and during the attack, and finally many of the sequelæ of fever (excepting always anæmia) may be very advantageously treated by the sulphites. . . . In the treatment, if sulphite of soda be used, the proportion is 300 grains of the salt, in about six ounces of water sweetened with honey or some aromatic syrup. This quantity is given in twenty-four hours in divided doses. . . . It is essential to take the remedy one hour before or two hours after a meal, and not to drink, except after a long interval, any acid liquid, such as lemonade, or to take acid fruits or vinegar. As a prophylactic 150 grains of the sulphite, or 120 grains of the hyposulphite, of soda, may be given daily in two doses, morning and evening, dissolved in water. This dose can be taken without inconvenience for several months together."[1]

In this country evidences of the efficiency of this treatment have been published by Leavitt, North, Baxter, Hampton, Turner, Little, and others.[2] They leave no doubt whatever of the curative powers of the medicine in malarial fevers, even when due allowance has been made for the tendency which many cases of these affections have to a spontaneous cure, and for the influence of the imagination of the patient in favor of a new remedy. Out of 220 cases only two or three failures are reported, and in many instances the medicine effected a cure after the failure of quinia. On the other hand, it is certain that quinia has cured where the alkaline sulphites have failed to do so. On the whole, therefore, we think it may be admitted that in these compounds we possess one of the most valuable succedanea for quinia that has ever been proposed. Dr. Leavitt has called attention to one of the conditions of the failure of the sulphites, viz., general ill health, and poverty of the blood in red corpuscles; but these are equally causes of the failure of all antiperiodic medicines, and form the ordinary indications for associating with them the preparations of iron and other blood making agents.

Typhoid fever is the subject of a very favorable report by the

[1] Practitioner, viii. 378.

[2] Amer. Journ. of Med. Sci., Jan. 1868, p. 284; Ibid., Jan. 1869, p. 39; Ibid., Jan. 1870, p. 280, etc.

Italian physicians, but one quite deficient in conclusive proofs. There, at least, appears to be no ground for abandoning the wise expectation which has resulted from a long and varied study of the disease, and of the influence exerted upon its course and issue by the measures which are now employed to guide, rather than to arrest it. A Scottish physician, Dr. J. W. Miller, treated 161 cases of *typhus fever* with the sulphites, and 723 cases by the ordinary method. In the two series of cases the mortality was the same within a fraction; and no influence whatever was to be ascribed to the sulphites upon the course and individual symptoms of the disease.[1] The same remarks are quite as applicable to *diphtheria*, and to *variola*, *scarlatina*, and other eruptive fevers, for which a cure is alleged to have been found in the sulphites, by certain enthusiastic physicians. One of these, returning to first principles, prefers to employ, instead of the sulphites, sulphurous acid in its purity, under the form of burning sulphur,[2] reviving thus the method of purification which has so long been the terror of Levantine quarantines, and the despair of all whose correspondence has passed through the same searching ordeal. But whether applied in this form by the gentlemen named to *diphtheria*, or in saline combination to the *continued fevers*, the results, so confidently announced as extraordinary, have not occurred in the practice of other observers.

Yellow fever is also reported by Dr. Fiddes, of Jamaica, to have been very successfully treated by sulphites. But, on examination, his report[3] only shows that the mortality was less than that of the epidemic of the previous year by a certain percentage. There is no comparison of cases during the same epidemic treated by different methods; nor is due allowance made for the disuse of the calomel and quinia treatment; nor, finally, is its appropriate share in the apparent result allotted to the use of the wet sheet; although the immediately beneficent operation of this appliance is emphatically recognized. As yet, therefore, it would seem prudent not to depend upon the new remedy.

A rational and apparently successful application of the sulphites has been made by Dr. J. H. Griscom, to the treatment of fermentative *dyspepsia* accompanied, as it usually is, with flatulence, eructations of wind and food, and sometimes with colic and diarrhœa. In doses varying from five to sixty grains, administered from two to six times a day, it seems effectually to counteract these symptoms.[4]

Purulent infection—or *septicæmia*—appears to be the disease of all others, to the cure of which the experiments of Polli directly point, and the anticipation has not been proved to be altogether vain. Taguiri, De Ricci, Rodolfi, Caparelli, Ferrini, in Italy; Spencer Wells and others in England; Davis, Fisher, and Atlee,[5] in this country, have published cases which are supposed to prove the effi-

[1] Edinb. Med. Journ , xv. 210
[2] Dr. Cummins, Dublin Quart Journ., Nov. 1869, p. 219.
[3] Edinb. Med. Journ., xiii. 389.
[4] Trans. Med. Soc. of State of New York, 1868, p. 119.
[5] Am. Journ. of Med. Sci., Jan. 1865, p. 82.

cacy of the sulphites in moderating the symptoms of the disease in question, and in saving lives which no other method of treatment could have been reasonably expected to preserve. But in some cases other measures were simultaneously employed, the exhibition of opium for instance, a fact which vitiates, to a certain extent at least, the conclusions which the reporters desired to draw in favor of the efficacy of the sulphites.

On the whole, and not to occupy more space with a statement of claims which seem at present to be excessive, we are disposed, except in so far as they relate to malarial fevers, to adopt the conclusions of Semmola, Professor of Clinical Medicine at Naples, when he says: "Diseases which have been attributed to a morbid fermentation, such as typhoid fever, scarlatina, measles, and malarial affections, are in no wise influenced by the sulphites, and their grave types continue to be fatal notwithstanding these remedies. Syphilis, malignant pustule, and purulent infections are equally unaffected by their operation."[1]

The true field for the operation of these medicines is in the destruction of the products of decomposition, by which means they prevent the action of *putrid emanations* upon the sense of smell, their inhalation into the lungs, and their absorption into the blood from these organs, the digestive canal, the skin, etc. They are, in a literal sense, disinfectants. Thus they are very efficient in destroying the odor and probably the infectious qualities of *dysenteric* and *choleraic* stools, and the offensive smell of all other discharges. In the *stomach*, and *bowels*, and *bladder*, etc., they arrest the progress of decomposition, and therefore the disengagement of gas, the diarrhœa, the vomiting, or the catarrh, which the presence of fermenting liquids excites. Applied to *wounds* and *ulcers* they operate as wholesome stimulants, promoting granulation or cicatrization, and limiting, while they maintain unaltered in quality, the secretion of pus. They also diminish in a notable manner the sensibility of such parts.[2]

The sulphite and the hyposulphite of sodium are among the substances which may be used to decolorize solutions of *iodine*. For the former, the following formula may be used: Take of tincture of iodine, and of glycerin, each an ounce, sulphite of sodium, a drachm; rub the salt to a powder in a small mortar, and add the glycerin gradually, then pour in the tincture of iodine and triturate gently.[3] For the latter, and also for the bisulphite, a saturated solution may be added in the proportion of about one-sixth to the tincture of iodine. Or a few small crystals of the hyposulphite, or a little of the powder of the bisulphite, may be added to the undiluted tincture.[4]

Administration.—The officinal sulphite of sodium or potassium

[1] Bull. de l'Acad. de Méd. xxix. 1003.
[2] Vid., among other witnesses, Dewar, Times and Gaz., Sept. 1867, p. 318.
[3] Boston Med. and Surg. Journ., Sept. 1872, p. 207.
[4] Med. Record, ii. 375.

is generally employed for internal use, but the magnesian sulphite is preferred by some physicians, because it is less unpalatable and contains a larger proportional quantity of acid than the soda salt. As an external application the sulphite of sodium is preferable. The sulphite of calcium is regarded as a more appropriate internal medicine when diarrhœa exists. When administered internally the sulphites may be given in doses varying from *fifteen to sixty grains*, at intervals of three or more hours. Infusions of balm, mint, and other mild aromatic substances form appropriate vehicles for their exhibition. For external application, a solution of half an ounce of the salt in half a pint of water, may be employed. Its action may be prolonged by means of compresses wet with the solution to which glycerin has been added. The dressing should be covered with oiled silk.

ARGENTI NITRAS.—Nitrate of Silver.

Preparation.—Nitrate of silver is an artificial salt obtained by the direct action of nitric acid upon silver. It occurs under two forms. The one (*Argenti nitras fusa*) is in cylinders of about the diameter of a goosequill, of a whitish and afterwards a grayish-white color under the influence of light and exposure to the air, and presenting a radiated crystalline fracture when broken across. It is called fused nitrate of silver, from its having been melted and cast in moulds. The other form is that of colorless, transparent, shining, rhomboidal plates (*Argenti nitras*). It is generally a purer salt than the first, and better adapted on that account for internal administration and for use in solution.

History.—This substance was known to the Arabs in the sixteenth century. Its mode of preparation was described by Angelus Sala (1614), who called it *magisterium argenti*, or *catharticum lunare*. Half a century later it was recommended by Boyle and others under the name of *pilulæ lunares*. They attributed to it a vermifuge property, and employed it in dropsical diseases and for inveterate ulcers. Boerhaave informs us[1] that if two grains of this substance are made into pills with crumb of bread and sugar, and taken on an empty stomach, and some warm water with honey is drunk immediately afterwards, it will purge without griping. It had, however, been for a long time neglected when, about the close of the last century, it was employed anew in England and in this country, and became generally adopted on the continent of Europe as a remedy for epilepsy and other diseases of the nervous system.[2] Chapman ascribes its reintroduction into the Materia Medica to Sims, of London. Besides the names of the salt which have been mentioned, that of *vitriolum lunæ purgans* was given it by Geoffroy, and it is also known as *lapis infernalis*, *causticum lunare*, *argentum nitratum*, etc.

[1] Lewis, Mat. Med., i. 136. [2] Mérat and De Lens, Dict., i. 400.

Action. *On Animals.*—Orfila found that even very small quantities dissolved and injected into the veins of dogs produced dyspnœa and choking, succeeded by convulsive movements of the extremities, and then of the thorax, abdomen, and whole body. Vertigo followed, so that the animal could neither stand erect nor walk steadily, and also retching and vomiting. Death took place with evidences of pain and suffocation. Krahmer[1] found that sixty grains dissolved in an ounce of water, and administered to animals, produced no very severe symptoms. This dose was given to a dog for four days successively without producing ulceration of the stomach or death. Animals that cannot vomit, such as sheep and rabbits, are, it is true, affected more seriously, and are attacked with an inflammation of the stomach which sooner or later destroys them. When a large dose of a concentrated solution has been administered, the gastric mucous membrane is found to be softened and disorganized. Smaller doses produce an intense injection of this membrane, with spots of a grayish or blackish color. The latter alteration is most apt to occur when the poison is taken in substance. In that case, also, there may be perforation of the stomach. The pharynx, etc., may be the seat of similar lesions.[2]

On Man. Externally.—When this substance is applied to a raw surface, or to a mucous membrane, it produces a smarting pain, which lasts for several hours if the part is inflamed. When rubbed upon the skin, so as to cause vesication, it also occasions pain, but less than perhaps any other vesicant. Its contact in any of these cases, but particularly in those first mentioned, produces a white color by a combination of the caustic with the albumen or fibrin of the part; but this color gradually changes to brown, and then to black. The same effect is produced when the caustic is applied upon mucous membranes. If the rubbing of the skin is prolonged, redness is perceived around the discolored part, and vesication of the latter takes place, but never sloughing, as in the case of acids or of alkaline caustics, and in a few days the blackish film separates at the edges and exfoliates, leaving the skin beneath perfectly sound.

Internally.—Heller's experiments[3] appear to show, and they correspond with Orfila's, that neither in the blood nor urine of men or of animals can any trace of nitrate of silver be found, although considerable quantities of it may have been taken. The fæces, on the contrary, appear to contain the whole of the silver that had been administered. This is, however, clearly an erroneous estimate.

Krahmer found that in doses of one-fourth or one-half of a grain no distinctive symptoms were produced, but larger doses occasioned a burning sensation in the stomach, with nausea, malaise, and a peculiar sense of weariness. Diarrhœa is sometimes observed as an effect of large doses. Portal, indeed, ascribed the usefulness of the medicine in epilepsy to its purgative action. Its continued use

[1] Canstatt, Jahresbericht, 1846, p. 246.
[2] Wibmer, Wirkung, i. 216.
[3] Lond. Med. Gaz., July, 1846, p. 170.

probably lessens the appetite and the urinary secretion. Bodeley, Lombard, and other writers, ascribed to it a diminished tendency to congestion of the brain in epileptic patients; while Graves observed that when given to persons affected with various diseases, it occasions vertigo and headache. Portal, indeed, relates a case in which the exciting cause of epilepsy appeared to be a poisonous dose of lunar caustic. Several persons have ascribed to it a tendency to occasion hemorrhages. If its use is long continued, it usually gives occasion to the presence of albumen in the urine, and seldom fails to produce a more or less violet discoloration of the skin. When frequently applied to the conjunctiva, it stains this membrane brown.

Krahmer relates a case of poisoning by "*eight drachms*" (probably *grammes*) of nitrate of silver.[1] The symptoms were insensibility to tactile impressions, and loss of consciousness, with convulsions. The pulse was unaffected. Salt was soon administered as an antidote. In ten hours all parts of the body had regained their sensibility, and the patient was able to speak; but three hours afterwards coma took place, and continued for two hours. On the following days there was a good deal of pain in the epigastrium; but on the sixth day the patient was well. In a case reported by Mr. Scattergood, a child of fifteen months accidentally swallowed a piece of fused nitrate of silver three-quarters of an inch long. Convulsions occurred, and vomiting was artificially provoked; in two hours a liquid stool, with a quantity of white curdy substance, was passed. The child then slept for half an hour, when the convulsions were renewed and continued for two hours. The extremities then grew cold, the skin cold and clammy, the pulse very faint, and death in a violent convulsion occurred six hours after the poison had been swallowed. On examination of the body cadaveric rigidity was marked; in the œsophagus were two or three small patches of corrosion. In the stomach a corroded patch extended from the cardiac orifice four inches along the greater curvature. It was of a brilliant white color. A similar color stained the edges of the valvulæ conniventes in the duodenum. The heart was empty and contracted.[2] Many examples might be cited in which fragments of caustic have accidentally fallen into the œsophagus, and been swallowed, without injury. To understand these comparatively mild effects of so large a dose of poison, it must be remembered that it combines readily with albumen and gelatin, so that if the stomach contains a sufficient supply of its natural mucus, or of albuminous or gelatinous food, the caustic effect must be in a great degree counteracted. If nitrate of silver is administered in small doses, or associated with neutral substances, its caustic action on the mucous membrane itself must be very slight indeed.[3] In the following case by Dr. Frommann, it would seem that more serious results may follow doses intended to be medicinal. An epileptic took one

[1] Canstatt, op. cit., 1846, p. 247.
[2] Brit. Med. Journ., May, 1871, p. 527.
[3] R. D. Thompson, Am Journ. of the Med. Sci., xxiii. 205.

and a half grain of the salt daily for three weeks, and then for nine months a daily dose of six grains. A suspension of the medicine was rendered necessary by gastric disturbance consisting of anorexia, pain excited or increased after taking each dose, vomiting first of ingesta and then of blood. On suspending the use of the nitrate the symptoms in a great degree declined, but pulmonary phthisis rapidly terminated the patient's life. A very extensive ulcer occupied the posterior wall of the stomach, a portion of it having penetrated to the pancreas. There was also a narrow stricture of the pylorus formed by an excessive hypertrophy of the muscular and submucous coats. It is possible, indeed, that these lesions may not have been occasioned by the caustic action of the salt, but have belonged to the class of simple idiopathic ulcers of the stomach. But as their first occurrence coincided with the administration of what must be regarded as very large doses of nitrate of silver, and as their symptoms materially subsided when the medicine was discontinued, this agent seems not unjustly to be chargeable with aggravating if not of primarily occasioning the gastric disease. A case is reported of a woman who used nitrate of silver for two months, beginning with one-fifth of a grain, and finally taking two grains daily. Soon after discontinuing the medicine she suffered with swollen and red gums with a purple line at their attachment to the teeth, and great tenderness and pain in the mouth. There was no salivation, but the breath had a metallic odor. The skin was not discolored.[1] Some writers have objected to the name of caustic applied to this salt, on the ground that, unlike potassa, for instance, instead of softening and dissolving animal tissues, it, on the contrary, coagulates and hardens them.

As before remarked, when taken into the stomach it is, after conversion into chloride of silver, as some maintain, carried by the bloodvessels to the skin, where, by exposure to light, it gives to the integument a violet hue. Others suppose that it is absorbed as nitrate of silver, and is converted into a chloride in the rete mucosum (*Thompson*, *Deloux*); Patterson and Van Geuns,[2] however, suppose the chloride to be decomposed by the action of light, and metallic silver to be deposited as the discoloring agent. According to Brandes, it exists in the skin as an oxide, and one case at least is recorded in which the oxide of silver taken for a length of time produced the characteristic slate-color of the skin.[3] According to Krahmer, it forms an albuminate. Butini relates[4] the case of an epileptic who had taken altogether five ounces and ten grains of this medicine. His scalp had a grayish-blue color, and his face a dark blue-black tint. Some small scars on the cheeks retained their original color. The mucous membrane of the mouth showed the same change as the skin, but less distinctly. The conjunctivæ were discolored like the face, and the vessels appeared grayish-brown.

[1] Bull. de Thér., lxxi. 86.
[2] Dub. Quart. Journ., Aug. 1858, p. 244.
[3] Milton, Journ. of Cutan. Med., ii. 42.
[4] Richter, Ausfür. Arzneim., iv. 422.

The portions of the body habitually covered with clothing were but slightly tinged. A case is reported by Wedemayer,[1] of a person who had taken the nitrate of silver for a year and a half, and whose internal organs after death had, all of them, more or less of a bluish tint. A more recent and very similar case is reported by Frommann,[2] who also proved the presence of silver in the discolored tissues; and another by Mr. Sydney Jones, who obtained metallic silver from the choroid plexuses which were of a very dark color.[3] Oxide of silver is also found in the Malpighian bodies of the kidneys, where no doubt it occasions the albuminuria before alluded to. Gamberini met with a remarkable case of a woman whose health became seriously affected, while portions of her skin acquired the characteristic hue produced by the absorption of nitrate of silver in consequence of her having used a pomatum containing this salt for the purpose of dying her hair.[4] When a blister rises upon skin thus discolored, the contained serum, as well as the cuticle, presents its natural appearance. No means have been found capable of removing the stain, although it has been asserted that diluted nitric acid internally, or iodide of potassium internally and externally, will have this effect. The latter agent, and also the cyanide of potassium, readily efface the stains made by lunar caustic when applied to the skin. A chemist of Lyons states that the same effect is produced by flaxseed mucilage.[5]

The operation of the salts of silver has been illustrated by the thorough and numerous experiments of Bogoslowsky.[6] The most important result, and that which, perhaps, serves as a key to the remainder, relates to the blood. Silver, it is stated, produces a decidedly antiplastic effect on the blood, rendering it more fluid, and darker; the red corpuscles give up their hæmoglobulin and become transparent and pale, the hæmoglobulin passing gradually into hæmatine, and this in its turn goes to increase the formation of bile. The urine declines in quantity but gains in specific weight, and the fæces are increased in quantity and grow darker. All the mucous membranes become affected with catarrh, and the urine contains albumen. The muscles undergo more or less fatty degeneration, and the blood stagnates in all the vessels, occasioning transudation through the serous membranes, and interfering with the normal nutrition of all the tissues. To these causes may probably be ascribed the paralysis of the bladder which in some experiments preceded the death of the animal by several days.

Uses. *Internally. Dyspepsia.*—Although it has been successfully used in that form of dyspepsia which is attended with gastric pain and vomiting, yet no one before Dr. James Johnson[7] had clearly described the cases in which it is most appropriate. They are such as, in addition to morbid sensibility of the stomach and bowels, present disturbance of the mind and senses, and sometimes

[1] Dierbach, Neuste Entdeck., i. 527.
[2] Virchow's Archiv, xvii. 135.
[3] Times and Gaz., Jan. 1860, p. 100.
[4] Prager Viert., lxxiv. Anal. p. 49.
[5] Lancet, March, 1859, p. 279.
[6] Virchow's Archiv, xlvi. 409.
[7] An Essay on Indigestion, 1826.

of the motory nervous system, to the extent, it may be, of producing convulsive attacks. It was prescribed by Dr. J. in conjunction with bitter tonics, and especially quinia. Autenrieth observed its beneficial effects in dyspepsia following the suppression of a cutaneous eruption, or accompanying a gouty diathesis. Rueff extolled it in the nervous vomiting of children, and Hudson used it successfully in the same disorder. In chronic vomiting accompanied with spasmodic pain in the stomach no single remedy has been equally approved. Krüger, Fisher, and Hirsch report similar results when there are acid eructations, a vesicular eruption on the buccal mucous membrane, or a severe pain darting from the back to the epigastrium.[1] It has also been recommended by Parker, Copland, and Hudson,[2] in cases characterized by acute pain and tenderness in the epigastrium, distension of the stomach after meals, thirst, costiveness, and vomiting of a sour liquid. When these symptoms coincide with leucorrhœa, the nitrate of silver often cures the latter disease while it is relieving the former. It is very important in the treatment of gastric affections by nitrate of silver, that it should be given when the stomach is entirely empty, and particularly at bedtime.[3] It must not be concealed that physicians of authority have totally denied the efficacy of this medicine in the cases referred to. Dr. Brinton, for example, "has no hesitation in saying that, as ordinarily prescribed, it is totally inert; and that the benefits which have been observed under its use are due either to the diet, or adjuvant remedies also adopted, or to the curative efforts of nature."[4] But, on the other hand, the cases are numerous in which, as in one of M. Gros,[5] the diagnosis was well established, and all remedies failed to relieve the disorder, when the administration of nitrate of silver appeased the urgent symptoms and led to a substantial cure. If, as Dr. Brinton maintains, the effect is illusory and the medicine cannot be operative because it is neutralized, we should be without any explanation of its apparently curative virtues, not only in this affection, but in those considered in the following paragraphs.

Diarrhœa.—Graves recommended nitrate of silver in the diarrhœa of *phthisis*, as better than opium and astringents. He directed one grain three or four times a day. But he did not advise it when the bowels were supposed to be ulcerated. It is in these very cases, on the contrary, that we believe the peculiar advantages of the medicine are shown. We have seen the pulmonary symptoms of phthisis remain quiescent while the strength was rapidly wasted by frequent and profuse discharges from the bowels, which all means failed to moderate until nitrate of silver reduced their number to one or two in the twenty-four hours. Dr. Macgregor, of Dublin, used this remedy with striking advantage in ordinary chronic diarrhœa, as well as in that of phthisis.[6] It should be associated with opium in such cases.

[1] Dierbach, i. 528; iii. 638.
[2] Braithwaite's Retros., 1840, p. 73.
[3] Times and Gaz., Nov. 1859, p. 99.
[4] On Ulcer of the Stomach, p. 132.
[5] Bull. de Thérap., liii. 92.
[6] Lancet, Sept. 1841, 937.

Hirsch found it to possess almost specific powers in *diarrhœa ablactatorum*, when given in solution by the mouth and also by the rectum. Prof. Mauthner, physician to the Children's Hospital of Vienna, found it equally efficient even when given to new-born babes, in the dose of a quarter of a grain daily. He discontinued its use when the stools ceased to be serous and acquired a greenish color.[1] It has been very highly recommended in this, and in the inflammatory or *dysenteric* forms of bowel complaint occurring in infancy and childhood. It may be given by the rectum, dissolved in water (gr. ss to gr. ij, dissolved in water, f℥ij to f℥iv), after cleansing the bowel by a simple enema; or by the mouth, in the same or in proportionately smaller doses.[2] It is very favorably estimated by Eberle, Trousseau, and by Dr. J. F. Meigs, who remarks that when given by the mouth its influence over the disease is less immediate than when used by injection, but is more permanent.[3] By the former way a teaspoonful of the solution should be given every two or three hours, and by the latter the quantity mentioned above may be administered two or three times a day.

In the diarrhœa of *typhoid fever* it has been recommended by Boudin, Ebers, Kalt, J. K. Mitchell, and others. The local lesion it is intended to heal, the ulceration of Peyer's glands, which may be regarded as the cause of the diarrhœa, is not, however, the primary link in the morbid chain which constitutes the disease. The intestinal ulcers may, indeed, become a source of danger by producing excessive evacuations in an advanced stage of the attack, and at that time whatever tends to heal them may conduce to the patient's safety. To give the remedy earlier, or when the discharges are few or small, would be useless, if not hurtful.

In *Asiactic cholera* this medicine was found serviceable by M. Barth in controlling the alvine evacuations as well as in arresting the obstinate vomiting of the disease. He prescribed it in solution by the mouth and rectum, and in doses of one grain. Prof. Mauthner regarded it as very useful for children attacked with this disease. He directed three or four grains in two ounces of water to be given by enema every two hours.

Dr. Peebles affirms that he has had many occasions to demonstrate the value of this medicine in "chronic idiopathic *jaundice*."[4] The cases he had in view seem to have been those of chronic dyspepsia with epigastric pain and tenderness, and an icteric suffusion of the skin. In 1839, Retzius, of Stockholm, treated *amenorrhœa*, supposed to depend upon torpor of the uterus, by injecting a solution of lunar caustic (one or two grains to the ounce) into the cavity of this organ immediately before the menstrual period.[5] Kopp, of Hanau, considered this substance a powerful sedative of the abnormal action of the *heart*, both in functional and in organic diseases

[1] N. Am. Med. and Surg. Rev., ii. 504.
[2] Duclos, Bull. de Thérap., xxxvi. 241, 345, and lxi. 97; Gros, ib., lxi. 433.
[3] Diseases of Children, 2d ed., p. 369.
[4] Am. Journ. of the Med. Sci., July, 1849, p. 59.
[5] Dierbach, iii. 665.

of that organ.[1] There is some reason to believe that the medicine in a measure controls muco-purulent discharges from the lungs,[2] and the nightsweats that are apt to accompany them.[3] Franklyn, Bruce, Pittschaft,[4] and Powell[5] have reported numerous cases of the success of this remedy in *chorea*, but in most of them it appears to have been associated with agents of more demonstrable virtue. This was not true of Powell, however. He gave the remedy alone, and successfully, after the failure of other means.

Epilepsy.—Nitrate of silver is said to have been used by Paracelsus in this disease, and Stahl and Tissot recommend it. It seems, also,[6] to have been the principal ingredient of a secret medicine much employed for epilepsy in Austria during the time of Stahl. In 1794 Sims[7] reported it to have been very efficacious in his hands. "One effect," he remarks, "that I perceived in some of the successful cases, was that on beginning it the first paroxysms were aggravated, although the disease afterwards yielded to its continued use." Heim, says Romberg,[8] "found it the most effectual remedy for the disease that he had used during a professional life of sixty years. It was introduced by the British physicians Wilson, Harrison, and Roget. They administered it in doses of one, two, three, or even six grains, three times a day." It would scarcely be profitable to furnish a complete history of the results of the treatment of epilepsy by this medicine. As in the case of all other means used for curing the disease, it has often been successful, and much oftener failed completely. We may reasonably conclude that this result is owing to the cases of epilepsy being themselves extremely various in their nature. Existing data do not, it is believed, afford the means of distinguishing the several varieties of the affection so as to enable us to assign an appropriate set of remedies to each. The class which includes all the eccentric forms is probably the one in which this medicine finds its appropriate application, and the particular cases which it is best adapted to cure seem to be those in which the nervous temperament and a morbid susceptibility to impressions, united with a feeble or torpid state of the organic functions, exist. But the same is true of oxide of zinc, of certain narcotics, and of tonic treatment in general. It may well be doubted whether cases that resist the persevering and methodical use of these medicines will yield to nitrate of silver, and, indeed, our interest in determining its value is much less since we possess other remedies of more demonstrable power in this disease.

Progressive Locomotor Ataxia.—This peculiar form of paralysis, which chiefly affects the lower extremities, and consists not so much in a loss of muscular power as in impairment of muscular co-ordination, has been proved to depend essentially upon degeneration of

[1] Dierbach, iii. 663.
[2] Balfour, N. Eng. Journ., vii. 319.
[3] J. Ware, ibid., viii. 214.
[4] Richter, op. cit., iv. 431.
[5] Trans. of Lond. Coll. Phys. (1808), iv. 85.
[6] Copland, Med. Dict., art. Epilepsy.
[7] Memoirs of Med. Soc. Lond., iv. 379.
[8] On Nervous Diseases, Sydenham Soc. ed., ii. 228.

the posterior columns of the spinal marrow. It was regarded as a wholly incurable disease of indefinitely prolonged duration when Prof. Wunderlich published his successful treatment of several cases of it by means of nitrate of silver, in the dose of one-fifth of a grain twice and then three times a day. On comparing the cases reported by this physician and by Charcot, Vulpian, Herschell, Moreau, and others with those typical examples which were recorded by Cruveilhier, Canstatt, and especially by Friedreich,[1] it is evident that the greater number of the former were of a rheumatic nature, and originated in exposure to cold and dampness, while the latter were as plainly independent of any distinctly exciting cause. It is also true that several of the first class were rescued by the use of nitrate of silver from a most deplorable state of muscular disability, while none which were clearly of the second class were benefited by its use. Indeed, Friedreich says emphatically of the cases so minutely reported by him, "nitrate of silver was employed persistently and in gradually increasing doses, but gave not the slightest indication of even a transient utility." Hitzig expresses almost as decided an opinion of its inefficacy in typical cases of the disease, and points out its tendency to irritate the digestive organs.[2] Among other cases may be mentioned two reported by Dr. Hingston,[3] and two others observed at Naples.[4] The first two alone were characteristic examples of the disease, and were benefited distinctly by the subsidence of the darting pains in the limbs so long as the medicine continued to be given, and also by the arrest of the progressive paralysis. Dr. Hammond also attaches some importance to the medicine without attempting to measure it accurately, since in his cases its use was associated with ergot and galvanism.[5] It must therefore be reckoned among the agents which should be tried whenever the peculiar muscular condition referred to exists, and when those medicines have failed to cure which general experience has approved.

Other Forms of Paralysis.—It is worthy of note that the first case in which nitrate of silver was used in the treatment of paraplegia was not of that form principally referred to in the last paragraph, but one of hysterical paralysis, which it speedily cured.[6] Later cases presented still other characteristics, and some among them arose evidently from concussion. One of this description is reported by M. Bouchut. It was that of a child five years old who lost the power of her lower limbs by a fall upon the buttocks, and who, when a sufficient time had elapsed to judge whether a spontaneous cure would occur, was treated by sulphurous baths, but without benefit. A tenth of a grain of nitrate of silver was then administered morning and evening, and in three days improvement was manifested. The dose was then changed to one-fifteenth of a grain

[1] Virchow's Archiv, xxvi. and xxvii.
[2] Brit. and For. Med.-Chir. Rev., April, 1868, p. 535.
[3] Times and Gaz., Nov. 1867, p. 538.
[4] Bull. de Thérap., lxxiii. 183.
[5] Dis. of the Nervous System, p. 513.
[6] Archiv der Heilkunde, ii. 193.

three times a day, afterwards increased to six times a day. In about six weeks the cure was complete.[1]

A very singular case as regards its origin in a fall which produced concussion of the spinal cord is related by Deguise.[2] The patient, a girl of fifteen, continued paraplegic, without impaired sensibility, for more than two years, during which time every remedy, both internal and external, was fruitlessly employed, when one-fifth of a grain of nitrate of silver was prescribed to be taken daily. In three days new sensations in the limbs were experienced, in a fortnight a degree of motility was regained, and within six weeks the cure was complete. Bouchut has also reported several examples of the cure of paraplegia and progressive general paralysis by this remedy, where the disease appeared to result from excessive indulgence in sexual or alcoholic debauchery, and in one case partly from the use of tobacco. He administered the medicine in doses of from two-fifths of a grain to one grain daily.[3] Raciborski used the same dose successfully in a case of diphtheritic paralysis.[4]

Locally. Croup.—The earliest notice of the employment of lunar caustic in the treatment of this disease (*pseudo-membranous laryngitis*), appears to have been by Prof. Mackenzie,[5] in 1825. Observing that the pseudo-membranous exudation very frequently commences on the surface of the tonsils and thence spreads upwards along the arches of the palate, and downwards upon the pharynx and into the larynx, he applied a solution of this salt (gr. xx to water ʒj) by means of a camel's hair brush, once or twice a day, to the whole lining membrane of the fauces, and, when necessary, to the lower part of the pharynx. He found that it uniformly alleviated the symptoms, and generally caused an exfoliation of the false membrane. Gendron claims to have treated pseudo-membranous angina by the same means and in the same year.[6] In 1826, Dr. Lewis Belden, of New York, treated ten cases of pseudo-membranous angina and secondary croup with solid caustic, or a saturated solution of it applied on a swab to the parts affected.[7] In 1828 Bretonneau,[8] and also Guimier, made use of the same method, and almost simultaneously Mr. Webster, of Dulwich, England, described the beneficial effects of the remedy in a "peculiarly fatal affection of the larynx," which appears to have been pseudo-membranous angina with secondary croup. He applied the solid caustic to the fauces and the parts bordering upon the glottis, and also to the skin of the neck covering the larynx and trachea, and sometimes used a solution of the salt of the strength of ten grains to the ounce.[9] About this time Gérouard recommended a similar treatment, advising that the caustic should be introduced into the larynx, and Authenac published some cases in which cauterization had proved

[1] Bull. de Thérap., lxiv. 57. [2] Ibid., lxvii. 407.
[3] Ibid., lxix. 502. [4] Am. Journ. of Med. Sci., April, 1865, p. 485.
[5] Edinb. Med. and Surg. Journ., xxii. 294.
[6] Journ. Complement., xxx. 269–275.
[7] Am. Med. Recorder, xiii. 125. [8] Dierbach, Neuste Entdeck., i. 534.
[9] Higginbottom, Essay on the Use of Nitrate of Silver. Appendix.

very beneficial.[1] In 1833, J. H. Robertson used a solution of from forty to sixty grains to the ounce, as an application to the posterior fauces, tonsils, and pharynx, in what seem to have been cases of œdematous laryngitis.[2] In 1837, Hatin published his treatment of four cases of croup (?) according to the method of M. Peronneau. He cauterized the whole posterior fauces, holding the tongue down by means of a spatula made by bending a metallic blade at an obtuse angle, and he remarks that the larynx may be entered for the purpose of destroying false membrane, even after it has extended to the trachea.[3] In 1839, Bretonneau successfully treated a case of secondary croup in the adult, by means of a solution of nitrate of silver (gr. cl to ℥j of water), which he introduced into the larynx by pressing a sponge saturated with the caustic upon the opening of this organ behind the epiglottis.[4] In the same year Asmus employed solid caustic in the same manner, and for the same disease.[5] In 1841, Dr. R. W. Gibbes, of South Carolina, cauterized the fauces with a saturated solution of the salt, in a case of croup; and by its means evidently saved his patient's life.[6] In 1843, Nonat applied a solution of caustic to the glottis in a case of membranous croup, which recovered. In 1847, Latour reported a successful case in which the solution was expressed into the larynx from a ball of lint between the blades of a pair of forceps.[7] In 1847, also, Dr. Ware, of Boston, was induced, by the reported success of the method in New York, to make a trial of it, which he did with gratifying success.[8] Various other cases were reported about the same time, which prove on examination to have been examples of stridulous laryngitis, but which were, owing to the imperfect knowledge of the gentlemen in charge of them, subjected to harsh and very unnecessary treatment by cauterization of the larynx. Five cases, however, in which the method was used by Dr. Clark, of Boston, were not of this description. Three of them recovered, and one of these was a very serious case. It evidently was cured by the cauterization. The same remark applies to two later cases treated by the same physician.[9] In 1861, Prof. Clar, of Gratz, employed by inhalation, the vapor of a hot solution of this salt (gr. xx to f℥j) in a case of *membranous angina* which had resisted the application of the solid nitrate of silver.[10] In this instance the beneficial action of the warm vapor of water alone was probably under-estimated.

In 1848, Dr. Horace Green, of New York, published a small work on the pathology and treatment of croup, in which, although no evidence was furnished of the author's acquaintance with any of the numerous precedents that have here been cited for the use of lunar caustic in the disease, he set forth the advantages not only

[1] Med.-Chir. Review, xiii.
[2] Ibid., xxiv. 155.
[3] Revue Médicale, lxviii. 31.
[4] Gaz. Méd. de Paris, Juin 23, 1839.
[5] Dierbach, op. cit., iii. 661.
[6] Am. Journ. of Med. Sci., April, 1842.
[7] Month. Journ. of Med. Sci., Oct. 1847.
[8] Boston Med. and Surg. Journ., Dec. 22, 1847.
[9] Ibid., Jan. 1859, p. 449.
[10] Prager Vierteljahrs., lxxv. Anal. 37.

of its application to the pharynx and glottis in substance, and to the larynx by means of instillations, but he also advocated the direct cauterization of the whole interior of the larynx and trachea. For this purpose he recommended the use of the same instrument which Bretonneau and Trousseau had long before employed, a curved whalebone rod armed with a sponge holding a strong solution of nitrate of silver. This he advised to be carried into the larynx, and as much further downwards as the disease is conjectured to extend.[1] He also described a spatula essentially the same as that used by Hatin.

These illustrations demonstrate conclusively that cauterization of the parts on which a croupal membrane is forming, as the effect of local inflammation only, will often suffice to arrest its progress, while, if allowed to run its course, it will be in almost every instance fatal. Thus, when the pseudo-membranous deposit commences upon the tonsils or pharynx, the desired result may be obtained by thoroughly cauterizing the parts on which it is situated; and when the membrane has invaded the larynx, or has originally commenced in that organ, the instillation of a strong solution of lunar caustic through the rima glottidis materially increases the chances of arresting the subsequent progress of the exudation. But no evidence exists to render it probable, and still less to prove, that the introduction of a sponge into the trachea (if possible) has been serviceable in any case. In the absence of direct proof of the necessity of attempting so extreme a measure, reason points to the imminent danger of crowding into a firm plug whatever tubular membrane may line the larynx or the trachea at its upper part, and exposing the patient to the danger of suffocation.

The general statements which are apt to be made by enthusiastic advocates of this method are more positive and more favorable to its success than are warranted by the facts which have been published in detail. In the work of Dr. Horace Green, above referred to, and in a later publication by the same author,[2] as well as in the papers of Dr. E. N. Chapman,[3] the evidence that the disease treated was really membranous croup is unfortunately wanting in nearly all of the cases. To those who will remember that the only positive sign of this disease, and the only one in particular that distinguishes it from simple acute laryngitis, is the rejection of false membrane, which, again, should not be confounded with mucus coagulated by a solution of lunar caustic, many of the cases here referred to must appear embarrassing if not illusory. Unquestionably they are not all of the same nature, and cannot with equal propriety be adduced to sanction the treatment they are intended to illustrate.

Chronic Affections of the Larynx.—Cauterization of the larynx has been more or less employed for many years, and especially to re-

[1] Observations on the Pathology of Croup, with Remarks on its Treatment by Topical Applications.

[2] Am. Med. Monthly, and The Charleston Journ., ix. 550.

[3] N. Y. Journ. of Med., xii. 213, and xiii. 68.

lieve chronic inflammations of this organ. It seems to have been first practised by Sir Charles Bell, in 1816, in a case of ulcerative laryngitis which bore the marks of a syphilitic nature. The patient was threatened with suffocation, and was unable to swallow liquids, on account of their passing into the larynx. A small pad of lint was fastened to the end of a catheter wire, which was bent so as to pass readily over the root of the tongue and the epiglottis. The fingers of the left hand of the operator being used to hold down the tongue and guide the instrument, its pad was saturated with a solution of lunar caustic (gr. xl to ℥j of water), introduced *into the opening* of the glottis, and pressed with the forefinger. The effect of this application was immediate relief. It was repeated several times along with other treatment, and the patient recovered.[1] In 1828, a writer in an English periodical mentions having recently seen some cases where *chronic coughs*, accompanied by muco-purulent expectoration, that had harassed the patients for years, and baffled all their physicians, gave way in a very rapid manner to a few applications of a solution of lunar caustic on the sponge of a common probang.[2] In 1832, Bennati recommended cauterization of the uvula and fauces with lunar caustic, to improve the voice when it is weakened, and has its musical scale deranged by swelling or relaxation of these parts. In the same year Trousseau, for the first time, employed a saturated solution of nitrate of silver successfully for the relief of *aphonia*.[3] He then made use of the species of probang, which Bretonneau had contrived, and which has since been universally adopted for cauterization of the larynx. A few years later (1836), this physician, in conjunction with M. Belloc, published his celebrated essay on Laryngeal Phthisis,[4] a translation of which appeared in this country in 1839. He made use of the instrument just alluded to, for applying to the interior of the larynx a solution of caustic (gr. lx or gr. cxx to ℥j of water), but gave the preference to a long syringe with a curved tube, from which the solution, mixed with air, was thrown into the glottis. His memoir contains seven cases of *subacute* and *chronic laryngitis*, which were entirely cured by this method, and several others of *tuberculous* and of *cancerous* disease of the same organ, the symptoms of which it palliated. In Dr. Watson's Lectures, which were published in this country in 1844, and very extensively circulated, the method of direct cauterization in chronic affections of the larynx is fully described. The use of the plan by Sir Charles Bell is stated, together with the fact that Dr. Arnott had twice or thrice "swabbed" the upper part of the larynx at the request of Dr. Watson, and also that the practice had been much followed by Dr. Vance, a naval surgeon. In 1846, Chomel described the symptoms of clergyman's sore-throat under the name of "granular affection of the pharynx," and stated that the only means to be relied on for its

[1] British and For. Med. Review, Oct. 1847, p. 498.
[2] Méd.-Chir. Rev., xiii. 459.
[3] Bull. de Thér., i. 163, 276.
[4] Mém. de l'Acad. de Méd., tom. vi.

cure are caustics, either in the liquid or the solid form, but of the two he preferred the former.[1] More recently the method acquired a temporary popularity from there having been deceptively attributed to it a power of curing or preventing *tuberculous consumption* of the lungs by its action on tuberculous ulcers of the larynx and trachea, and also from the singular dexterity acquired by the suggester of this idea, in "swabbing (to use Dr. Watson's term) the air passages.[2] Dr. Horace Green, the physician alluded to, informs us that he has passed the probang "at will, in many instances, into the right or left bronchus, with as much ease and safety as the catheter is introduced into the bladder."[3] He has also published an account of his successful introduction of tubes into the larynx, trachea, and bronchi, through which solutions of nitrate of silver and other medicinal substances were injected.

These extraordinary statements having led the New York Academy of Medicine to appoint a committee to investigate them, Drs. Parker, Wood, Metcalfe, and Stone presented a report to that body, setting forth that numerous experiments were conducted in their presence by Dr. Green and others, from which it appeared that it was possible to introduce a No. 10 catheter into the trachea, without serious discomfort to the patient, eleven times out of nineteen, when the instrument has the curve of a circle of six inches in diameter; that a similar tube "slightly bent at its extremity" failed to enter the larynx thirty-four times out of thirty-seven; and that the sponge probang failed to pass beyond the vocal cords in every one of eighteen trials.[4] These experiments ought, we apprehend, to set at rest the dispute as to the utility of an operation the very possibility of performing which is so strongly controverted, if not absolutely disproved. In regard to catheterizing the air passages, even if it were proved to be an easy operation, no proofs have been adduced to demonstrate its superiority over the ordinary administration of remedies by the stomach, and especially by inhalation, while the value claimed for it in the treatment of tuberculous phthisis is not less preposterous in theory than it is delusive in practice. But the partial evidence of its practicability admitted by the Committee of the Academy has been proved to be deceptive by Prof. Griesinger, of Tübingen.[5] This Committee admitted, with Dr. Green, that the alternate inhalation and expulsion of air through a tube passed beyond the fauces proved that its distal extremity was within the air passages; but Prof. Griesinger has shown that precisely the same phenomenon may take place with air drawn into the stomach through a tube passed into this organ by the œsophagus. The air, however, enters during expiration, and is forced out during inspiration. The only argument, therefore, that has hitherto appeared to support the assertion that the

[1] Abeille Médicale, iii. 184.
[2] A Treatise on Diseases of the Air-Passages, etc., by Horace Green, A.M., M.D.
[3] Lancet (Am. ed.), Nov. 1852, p. 346.
[4] N. Y. Journ. of Med., N. S., xv. 144.
[5] Deutsche Klinik, July, 1858, p. 285.

air passages can be catheterized, falls to the ground, and with it the entire method of treatment which it supported.

The utility of cauterizing the larnyx after the manner of Sir Charles Bell, and Trousseau and Belloc, is very great in nearly all of the chronic diseases of this organ. In nervous *aphonia* its use is sometimes of great advantage, the caustic operating as a simple irritant, and neither more nor less efficiently than many others; even *paralysis of the vocal cords* has been cured by a nebulized solution of nitrate of silver. When this disorder arises from hygrometric conditions of the atmosphere, or from *subacute* or *chronic inflammation*, it is often curative.[1] The same may be said of it in relation to chronic inflammation of the mucous *follicles* of the *pharynx* and *larynx*, known as "clergyman's sore-throat," the *dysphonia clericorum* of Dr. Mackness, although in this affection hygienic means, and other medical remedies than this one, must be combined to remedy the asthenic condition of the system of which this troublesome affection is often a symptom.[2] To render the local treatment of this disease efficient it is necessary to act powerfully upon the hypertrophied follicles, for which purpose inhalations of a pretty strong solution of nitrate of silver (10 grains to ℥j) may be maintained for five minutes at a time, care being previously taken to cleanse the throat by means of a gargle of warm water, and drying the surface with a mop of lint or soft fine sponge. When the follicles are large it is preferable to attack each one separately by means of a saturated solution, or by touching them with a finely-pointed pencil, of the caustic. In *whooping-cough* nitrate of silver applied by inhalation, the sponge, brush, or syringe, sometimes exerts a remarkable control over the frequency and severity of the spasms. Even in more deeply-rooted and constitutional maladies, which find a local expression in the nostrils, larynx, or trachea, such as *syphilis*, *tuberculosis*, and perhaps in some degree, also, *cancer*, although this method can effect no cure, it may palliate the symptoms by rendering the ulcers of the larnyx, etc., less sensitive, and may even promote whatever tendency they have to heal. In 1861 Dr. Freund, of Oppeln,[3] used the vapor of a saturated solution of nitrate of silver in cases of *tubercular consumption*. He found that it diminished the sputa and improved their quality, while it allayed the cough and was followed by a general improvement in the patient's condition. He sometimes associated chloroform or tincture of belladonna with the argentine solution. The subsequent introduction into general use of hand and steam atomizers has provided a much more efficient method of employing this treatment, which is often of signal benefit not only in cases of tubercular phthisis, in which, indeed, its advantages are probably limited to its action upon the secreting surfaces of the air-tubes and tuberculous cavities, but still

[1] Trans. Med. Soc. Lond. (N. S.), i. 25.

[2] See a paper, by Dr. J. Scott, Month. Journ. of Med. Sci., July, 1850, p. 15; also Prof. Bennett, ibid., Nov. 1851, p. 462.

[3] Deutsche Klinik, Aug. 1861, p. 297.

more so in *chronic bronchitis*, for the cure of which, in its most aggravated forms, it offers a precious resource.

Mode of Cauterizing the Larynx.—The principal instrument consists, according to the description of M. Trousseau, of a whalebone rod, a line or a line and a half in diameter at its smaller extremity, which, after having been heated in boiling oil, is bent at a curve corresponding to an angle of eighty degrees, and then allowed to harden by being placed in cold water. The smaller end, having been cut to an edge, notched, and dipped into melted sealing-wax until well coated, is surrounded with a piece of fine and dense sponge, which, if it also has been warmed, adheres to the instrument very firmly. On being wet with water, the sponge expands, when it should be trimmed into an olive shape of about three-quarters of an inch long by half an inch in diameter. A somewhat smaller size is necessary for children. A well-furnished camel's hair brush is preferable to the sponge in many cases; it is softer, and more readily adapts itself to the laryngeal opening. In order to employ it, the sponge or brush having been saturated with the solution, yet so that none shall drip from it, the instrument is held like a pencil in the right hand, and the patient breathing fully and naturally, it is carried rapidly into the pharynx until the curve of the whalebone reaches the posterior wall of the pharynx. This contact excites an act of deglutition, during which the handle of the instrument is raised and its further extremity drawn forward, when it can be thrust against the opening of the larynx, and the solution expressed into this organ. Instead of allowing the tongue to remain free, the operation may be facilitated, in many cases at least, by using the bent spatula proposed by Hatin, or some analogous instrument, or else the finger, by which the tongue may be pressed downwards and at the same time drawn forwards. The epiglottis itself may often be made visible. A convenient depressor is that proposed by Dr. E. Watson, the blade of which is open like a horseshoe, and affords a better view of the fauces and controls better the movements of the tongue. The operation nearly always produces a momentary sense of suffocation, with retching or vomiting, which latter symptoms may continue for several hours. These difficulties are best overcome by accustoming the patient to cauterization of the pharynx before the larynx is attacked, and by a rapid and dexterous manipulation of the instrument. Sometimes, when the sponge has been forcibly thrust between the vocal cords, a violent spasmodic constriction of the larynx takes place, which prevents the instrument from being easily withdrawn. This should not be too actively resisted, lest either the diseased organ be wounded, or the sponge torn off from the whalebone.

Dr. W. H. Sherwood claims to have treated advantageously *chronic laryngitis* in *tubercular* patients by throwing a solution of nitrate of silver, of the strength of five grains to the ounce, into the larnyx and trachea through a hypodermic syringe. The tube of the syringe was thrust through the crico-thyroid ligament, and

about two drachms of the solution injected.[1] The method is one that hardly commends itself.

Diphtheria.—It has already been stated that a solution of nitrate of silver was early employed in the local treatment of that form of disease now called *diphtheria*, and that it was the origin of the practice of applying the same agent to the treatment, first of secondary and afterwards of primary croup. Indeed, the influence of the false doctrine which regarded diphtheria as an inflammation, to be cured by local treatment mainly, has survived almost until the present time. But it is now well established that such treatment is rarely beneficial. If the exudation is already formed (and without it the existence of the disease cannot be affirmed), cauterization will either not remove it or will not prevent its speedy renewal; as, therefore, it is essentially useless, and in young persons a very difficult operation, it is much better that it should not be attempted at all.

Whooping-Cough.—M. Berger attributed very beneficial effects to nitrate of silver, given internally, as a remedy for this disease,[2] and more recently Dr. E. Watson has reported cases of the striking success he obtained by cauterizing the pharynx and larynx. Every second day he applied a solution varying in strength from the proportion of fifteen to that of forty grains to the ounce of water, and he states that three or four such applications generally put an end to the paroxysms. Cauterization of the posterior fauces alone appeared to produce a decided amendment.[3] A nebulized solution of nitrate of silver (gr. j to f℥j) has been equally beneficial, and is much more readily applied to the young persons who are usually the subjects of this disease.

Tonsillitis.—It is well known that many stimulant gargles have been used to arrest the development of tonsillitis, but none of them can be compared in efficacy with cauterization by nitrate of silver. If thoroughly performed at any time before throbbing pain in the part announces the commencement of suppuration, the affection will seldom advance any further. The method is especially to be recommended for those persons who are subject to quinsy, for if duly applied during two, or at most three, days in succession, suppuration will very rarely take place.

The value of local counter-irritation in *neuralgia* is well exhibited by the effects of nitrate of silver, which Higginbottom applied so as to *blister* the skin along the course of the affected nerve. It would be sufficient to apply it over those points of the nerve which are most superficial, and where pressure with the end of the finger excites pain. As requiring less trouble and attention, it may form a convenient substitute for cantharides in these cases (vid. *Cantharides*). This caustic has also been applied over the course of *lymphatic vessels* inflamed by ulcers and wounds, as well as in idiopathic inflamma-

[1] New York Med. Journ , vii 235. [2] Annuaire de Thérap., 1846.
[3] Month. Journ. of Med. Sci., Dec. 1849, p. 1287. See, also, JOUBERT, Bull. de Thérap., xlii. 41.

tion of these vessels, so as to vesicate the skin. Behrens recommended it in *paronychia*, employed so as to produce a blister over the seat of pain. If the inflammation is in its first stage, it is generally cut short; and if the treatment does not succeed, the case is no worse than before, and an incision must be made. It is recommended to make a large opening, and cauterize the interior of the abscess.[1] Other forms of phlegmonous inflammation may be treated in the same manner.

Ophthalmiæ.—This caustic has long been employed in *chronic* inflammations of the eyes. Scarpa especially advocated its use for ulcers of the cornea and of the eyelids. It does not produce any inflammation of the surrounding parts, but rather allays the inflammation which already exists there. As Mackenzie remarks, it is much superior to any anodyne or sedative lotion, and even to any narcotic taken internally. When the ulcers are deep, the solid caustic is most efficient; when more superficial, a solution of from four to ten grains in an ounce of distilled water may be applied by means of a camel's hair pencil. But neither method should be used, except with extreme delicacy, when the ulcers show a tendency to heal. If *hernia* of the lining membrane of the anterior chamber, or of the iris, should occur, the projecting portion may be excised, and the opening touched with a caustic pencil. This remedy may also be employed to remove granulations of the conjunctiva, but it is less efficient than sulphate of copper.

It is in *acute* inflammations of the eye that the virtues of lunar caustic are most conspicuous, but especially in those of the *conjunctiva.* On this point Velpeau expresses himself as follows:[2] "Inflammations of the ocular conjunctiva, whether simple, granular, partial, general, or purulent, most frequently yield with astonishing rapidity to the use of this remedy. I have seen conjunctivitis with complete chemosis, whether treated at the second or third, or at the eighth or tenth day, stop short and disappear under its influence in a week's time. Purulent conjunctivitis, of the highest grade, has been dissipated by it innumerable times." "It is now well known that genuine purulent ophthalmia, whether that which attacks new-born children, the Egyptian, the epidemic, or the gonorrhœal varieties, resists all derivative and antiphlogistic treatment. The last-mentioned of these yields more promptly to a strong solution of nitrate of silver than to any other collyrium whatever. While yet the inflammation is moderate, a solution of seven or eight grains to the ounce generally suffices. When the secretion becomes distinctly purulent, and there is considerable chemosis, a solution of from fifteen to thirty grains to the ounce is not too strong; and when the conjunctiva is puffy and grayish, the eyelids red and tumid, a solution of from forty to sixty grains should be at once employed. With these solutions, however violent the attack may be, there is great hope of success so long as the cornea remains trans-

[1] Dierbach, op. cit., iii 681. Gunier, Bull. de Thérap., liii. 314.
[2] Bull. de l'Acad. de Méd., ix. 39.

parent. But, to attain this end, the solution must be thoroughly applied to the inflamed membrane two or three times a day, after first washing away the accumulated pus. With these precautions the advance of the inflammation may be abruptly terminated, and after the first day the solution may be less frequently applied, and on the following days its strength may be diminished, but gradually, and in proportion to the decline of the attack."[1] The method of treatment in ophthalmia neonatorum is essentially the same. For *blepharitis* the best form of application is an ointment, which must vary in strength from one to three or four grains to a drachm of pure lard, and which ought only to be applied after the parts have been cleansed of the concretions which cover them. When, however, the disease is chronic, and the conjunctiva has become thickened, the solid caustic is preferable. Various forms of solid caustic have been proposed, less active than the officinal salt and better adapted than solutions for a limited application. One of these which is strongly recommended consists of one-third of nitrate of silver and two-thirds of nitrate of potassa. In all cases in which a solution of caustic is to be applied to the whole surface of the conjunctiva, it should be introduced between the lids at the external canthus by means of a dropping tube or a small glass syringe. In the employment of this solution care should be taken not to persist in its use for too long a period, lest a discoloration of the conjunctiva should result, giving to this membrane a dirty grayish-brown stain, and producing a permanent and very obvious deformity. Cicatrices of the cornea are occasionally stained black by it.

An ointment of nitrate of silver, and also solutions of this substance, have sometimes been used successfully in the treatment of *ozæna*. Gallizioli reports four cases to have been cured by the use of an ointment containing eight grains of salt to an ounce of lard.[2]

Higginbottom proposed to use nitrate of silver as a *vesicant*, in order to prevent the danger of strangury and constitutional irritation produced by cantharides, as well as because it acts promptly. It induces a very copious discharge, without heat or pain after the first few hours. The vesicated part heals about the fifth day, without leaving either ulcer or scar. Dr. G. McClellan, of Philadelphia, was in the habit of using it to blister the brow in certain affections of the eye, and particularly *iritis*, in which we have seen its good effects. Delvaux relates several cases[3] in which local vesication promptly put an end to *pains in the chest*, which appear to have been neuralgic or rheumatic in their nature. This caustic often succeeds in arresting the bleeding from *leech-bites*. If the skin is the seat of the puncture, it should be raised in a fold and held for a moment during and after the use of the cautery, so as to permit the full action of the latter on the wound. A pointed probe, covered with powdered caustic, and heated near the flame of a candle till fusion occurs, presents the best instrument for this little opera-

[1] Mackenzie, op. cit., p. 238. [2] Bull. de Thérap., li. 277.
[3] Month. Retrospect, June, 1849, p. 130.

tion.[1] Higginbottom suggests that in cases of *punctured and lacerated wounds* the caustic should be applied within and around the orifice as far as any swelling extends. He states that it prevents the tenderness and pain of suppuration. But if this process have already commenced, he advises that the wound itself, as well as the adjacent parts, should be thoroughly cauterized. This treatment is recommended in wounds made by nails, hooks, bayonets, saws, venomous insects or reptiles, dissecting instruments, spiculæ of bone, etc.

Ulcers.—Small *ulcers*, and such as are free from active inflammation and discharge but little, and, also, are not exposed to much motion or friction, may often be healed by forming an artificial cuticle upon their open surface by means of lunar caustic. After cauterizing the sore and its edges, dry lint should be applied and sustained by a roller, nor should the dressing be disturbed before the third or fourth day. The application of the caustic may then be renewed.[2] In other cases, and when the sore is small, the caustic should be applied upon the surrounding skin also. No dressing is necessary. If matter forms underneath the eschar, it can be evacuated by a small puncture, which can then be closed by a touch with the caustic. In *indolent* ulcers, after reducing the irritation by rest and sedative applications, the part should be well cleansed and dried and then cauterized, after which lint should be applied and covered with linen spread with a mild ointment, and the whole supported by a compress and roller. The same process may be repeated every fourth day until cicatrization is complete. In general, the combination of this method with that by adhesive straps is the most effectual in the class of ulcers referred to.[3]

The practice of destroying *chancres* by lunar caustic seems to have originated with John Hunter. As he remarks, the operation, to be effectual, must be performed on the first appearance of the sore, while the surrounding parts are still uncontaminated, for it is essential that the whole diseased part should be removed. Ricord has fully confirmed the soundness of Hunter's doctrine. According to him, when a chancre is destroyed by caustic before the sixth day after infection, or according to Acton, within three days after the appearance of the vesicle, the cure is very rapid, and contamination of the system rarely follows. When once the chancre has become indurated, cauterization neither prevents nor favors constitutional infection. It can no longer be considered an ectrotic treatment. It has sometimes been objected to this method that it causes many innocuous pimples to be destroyed under a suspicion of their syphilitic character. But it has been well answered to this objection[4] "that it is far preferable to cauterize nine simple sores than allow one specific ulcer to gain ground." To apply the caustic, Hunter recommended that it should be pointed like a pencil, so that it may touch those parts only which are diseased. If a vesicle or pustule is to be destroyed, its contents should first

[1] Dierbach, op. cit., iii. 678.
[2] Higginbottom, op. cit., p. 112.
[3] Ibid.
[4] Acton, Lectures. Lancet, April, 1846, 457.

be evacuated by incision and pressure and the point of the caustic pressed into its cavity. The cauterization of syphilitic ulcers should be repeated as often as the eschar formed upon them is thrown off, and until the edges show a tendency to cicatrize, when these should be spared, while the centre of the sore is still lightly touched. No other dressing than a little lint is needed.

Bretonneau, Velpeau, and also Serres made some experiments upon the eruption of *smallpox* by removing the summits of the pustules and cauterizing their interior. When this was done within the first three days of the eruption, the pustules aborted and left no cicatrix behind them.[1] Although it has been objected to this plan that it creates pain and fever and exhausts the patient, and occupies a great deal of time,[2] yet there may be cases in which the prevention of scars may be cheaply purchased even by these inconveniences. Higginbottom recommends as preferable that a concentrated solution of the salt should be applied with a brush on the whole surface of the face and ears, on the second or third day of the eruption. In other diseases of the skin this remedy is seldom available. A weak solution of it may be used in *intertrigo infantilis*, the vesicular eruption so common behind the ears, in the groins, etc., of children, but cauterization of this, as of most other eruptions, exasperates it. In *zona*, it is true, the pain may be somewhat lessened, but perhaps at the expense of protracting the disease; *herpes circinatus* is nearly in the same case; in *eczema* it is useless or worse, and in *rupia* it has no appropriateness until ulcers form and the cutaneous eruption proper is extinct. It has been recommended for *frost-bite*, but it is neither as safe nor as efficient as turpentine, etc.

For *sore nipples*, Hannay used a finely-pointed caustic pencil to touch the raw surfaces of the fissures, after which he washed them with warm milk and water. The pain is severe, but brief, and dressings of carbonate of zinc complete the cure. In many cases the application must be several times repeated.[3] A weak solution of the salt has also been successfully used for the same purpose (4 to 6 grains to f ℥j of water). A piece of lint wet with the solution is applied to the nipple after the infant has nursed, but the part must be washed before the child takes the breast again.

The caustic treatment was very successfully applied by Higginbottom to the cure of superficial *burns and scalds*. Fricke employed it in burns involving the true skin, to prevent the formation of disfiguring cicatrices. He cauterized the whole burned surface after evacuating the vesicles and removing the epithelium, and on the following days renewed the application wherever new vesicles or moisture could be seen. In this manner a protecting scab was formed which, like cotton under similar circumstances, acted by excluding the air.[4] Indeed, J. E. Cox recommended the application of carded cotton after the use of the caustic.[5] The more

[1] Archives Gén., viii. 433. More recently see Times and Gaz., Dec. 1856, p. 591.
[2] Wilson, Dis. of the Skin, p. 64.
[3] Dierbach, op. cit., i. 536.
[4] Dierbach, op. cit., i. 536.
[5] Ibid.

superficial the burn is, provided the true skin is at all interested, the better does this treatment succeed.

Erysipelas.—Nitrate of silver has been very extensively used to allay the inflammation and arrest its progress in this disease. Some, like Liston and Elliotson, preferred to cauterize the sound skin beyond the limits of the erysipelas, while Higginbottom, with whom it is believed the practice originated (1828), made use of cauterization upon the inflamed surface and beyond it. He did not, at the same time, neglect depletion and purgation. The pain produced by this application is sometimes very severe, but it does not last long, and is followed not only by great relief to the local symptoms, but by a marked abatement of the constitutional disturbance also. In a more recent essay on the use of nitrate of silver in erysipelas,[1] this author reiterates his earlier statements of its value, and advocates an extension of its use to cases in which the scalp is affected even with the idiopathic form of the disease. For this purpose the solution proposed by Mr. Gooch (argent. nitrat. gr. lxxx, acid. nitric. gtt. vj, aquæ destill. f℥iv) is the best form of the caustic. The affected part must first be shaved, or the hair cropped very closely. The scalp should then be freed of its greasiness by means of soap and water, and afterwards washed with pure water to remove any portion of soap remaining. The concentrated solution may then be applied several times upon the inflamed part and to the extent of two or three inches beyond its margin. In the course of twelve hours it will be seen whether any part of the skin has remained untouched, or whether the inflammation has extended. In either case the solution must be applied again. Many authors might be cited who attest the value of this method, such as Tanchou,[2] Martin Solon,[3] Jobert,[4] etc., but the foregoing statements are perhaps sufficient to illustrate its value in the judgment of several competent authorities.

Dr. F. Hunt used the solid caustic to arrest *salivation* and cure the ulcerated gums resulting from this process. It is, however, a far inferior application to muriatic acid, or to chlorate of potassa. A solution of this salt forms a useful wash in chronic *otorrhœa.*

Gonorrhœa.—Attempts have been made to cut short this disease by means of a strong injection of nitrate of silver. The method is said to have originated with Carmichael. It was practised by Wallace,[5] who employed a solution containing fifteen grains to the ounce, and subsequently by Ricord.[6] The last physician was careful to point out that unless the remedy is used before the acute inflammatory stage, very serious mischief may ensue. Although the method, in his hands, sometimes produced wonderfully rapid cures, yet the extreme pain of its application and the severe inflam-

[1] Ranking's Abstract, 1847, i. 23.
[2] Lancette Française, 1831, v. 120.
[3] Bull. de Thérap., vii. 253.
[4] Annales de Thérap., Juill. 1843.
[5] A Treatise on the Venereal Disease (Dublin, 1833), p. 254.
[6] See also Johnson and Bartlett (1817), Edinb. Med. and Surg. Journ., xiv. 263; Arnott, McDonald, Debeny, etc., Ranking's Abstract, v. 221; Burnett, Lancet, May, 1833.

mation it sometimes excited, led him afterwards almost entirely to renounce its use. After the subsidence of the acute stage, however, when astringent injections in general become appropriate, none is more efficacious than a weak solution of this salt (gr. ij to f℥iv), made use of every three or four hours. Gonorrhœa of the glans penis (*balanitis*) is very advantageously treated by cauterizing the part superficially, and interposing dry lint between the glans and its covering. The lint should be renewed as often as it becomes saturated with pus. If the prepuce cannot be retracted, a stronger solution than the one mentioned (gr. xx–xxx to f℥j) may be injected through its opening.

Gonorrhœa in *females* is readily cured during its early stages by direct cauterization. The solid caustic may be applied, according to circumstances, to the vulva alone, or to the vagina. In the latter case, a glass speculum should be made use of, through which the mucous membrane may be cauterized in its whole extent, after which lint should be introduced. After the first application of the solid caustic, and also in mild cases, a strong solution of salt should be used every second or third day.

A large number of writers upon *leucorrhœa* speak favorably of its treatment by nitrate of silver. Hannay (1840) used solid caustic, introducing it as far as the os uteri, and while gradually withdrawing it, cauterized the whole mucous membrane of the vagina by giving a rotatory motion to the caustic-holder. He states that out of 300 cases, 280 were cured by a single application of the remedy. Other reporters are far from confirming these results. Some declare that the method cures but a small proportion of the number treated, others state that the cure is not permanent and radical, and others still that it produces no good effects whatever. These discordant results must unquestionably be referred to the circumstance that unsuccessful cases were principally those of uterine leucorrhœa, while those in which the treatment was curative were probably examples of a muco-purulent discharge from the vagina, nymphæ, etc. In the first variety an exclusively local treatment is seldom curative, unless the disease is confined to the neck of the womb. Vidal, it is true, cured some cases by the direct introduction of a caustic solution into the uterus, but these are exceptional cases, and the method itself, being a dangerous one, is not to be recommended. In vaginal leucorrhœa, on the other hand, when the disease has passed the inflammatory stage, or is originally subacute in its form, no local application is more effectual than the one in question. The strength of the solution should vary with the grade of inflammation; the more chronic forms requiring the strongest solution.

When leucorrhœa depends upon *ulceration of the uterus*, or is associated with it, no other application promotes so rapid a cure as cauterization with nitrate of silver. Cases sometimes occur in which this lesion is accompanied with *vaginismus*, one of the most distressing disorders of the female genital organs. The patient should be placed under the influence of an anæsthetic, and a thorough examination made of the vagina and uterus. In some

cases, it is true, the result will be negative and the treatment must then be directed against the hyperæsthesia as a nervous affection; but in other cases ulcers of the uterine cervix with or without vaginal leucorrhœa will indicate a local treatment in which nitrate of silver is one of the most efficient elements.

Chronic inflammation of the *bladder* has been successfully treated by means of caustic injections[1] of the strength of two grains to the ounce. Mr. Reeves[2] reports several cases in which the extreme suffering and annoyance of the affection were entirely removed by injections of twenty grains of the nitrate of silver in an ounce of water. Schultz cured *ascarides* of the rectum by clysters containing from ten to fifteen grains of nitrate of silver in four fluidounces of water.[3]

Nitrate of silver was employed by J. Hunter for the cure of *strictures of the urethra*, through which a bougie could not be passed, owing to the density of the obstacle or its position in the canal. He at first made use of a canula containing a wire, to the end of which a piece of caustic was firmly attached, and afterwards of a bougie with caustic let into its extremity. This he applied every day or every other day for a minute at a time, provided the inflammation produced did not forbid so frequent a repetition of the process. This method is applicable to spasmodic strictures and those of moderate extent. When the stricture is long and hard, cauterization is comparatively of little service, except to reduce the morbid sensibility of the part, and hence to render attempts at dilatation more successful. If, however, the stricture can be entered by the cauterizing instrument, the action of the latter will facilitate the passage of bougies. An instrument, invented by Ducamp and improved by Lallemand, may be employed to cauterize the sides of the stricture when it can be entered. It is also very convenient for making local applications of caustic to any part of the urethra, and to the neck of the uterus. It has been very extensively employed in cases of *involuntary emissions* of semen to cauterize the prostatic portion of the urethra.

Lunar caustic is a useful agent in removing *corns*. The hardened and thickened cuticle should first be softened by warm water or a poultice, and then pared away carefully so as to avoid drawing blood. The corn should then, after being moistened, be thoroughly rubbed with the caustic. In about a fortnight, or whenever the blackened eschar is about to separate, the same process should be repeated, and afterwards nenewed if necessary. Like acetic acid, nitrate of silver in solution has been injected into a *cancerous* tumor, by Thiersch, with the effect of causing it to diminish materially in size. He employed one part of the salt to two thousand of water.[4] The same method was adopted by Nussbaum in fifteen cases. The operation is described as exceedingly severe, and a careful analysis of its results demonstrates its uselessness.[5]

[1] Am. Journ. of Med. Sci., Oct. 1847, p. 481.
[2] Lancet, June, 1853, p. 536.
[3] Times and Gazette, June, 1858, p. 586.
[4] Arch. Gén., Jan. 1867, p. 97.
[5] Bull. de Thér., lxxiii. 522.

Administration.—Nitrate of silver may be given internally, in substance or in solution, but the former mode is almost universally preferred. It is generally prescribed in the pilular form made up with crumb of bread, as it was originally by Boyle, in 1672. But as this substance contains salt, which decomposes the nitrate, in part at least, the latter may be triturated with some vegetable extract, or some mild vegetable powder with mucilage. The dose is at first about one-quarter of a grain three times a day, but may be gradually increased to five, ten, or more grains in the same space of time. If given in solution, it ought not to exceed one-third of that mentioned. No food containing salt ought to be taken immediately before or after its ingestion. A convenient mode of preserving fused lunar caustic is to dip it into melted sealing-wax, by which means it gets a coating which protects it from the air. It may then be cut to a point like an ordinary pencil.

Antidote.—Chloride of sodium (common salt), largely diluted and in sufficient quantity to produce emesis, has generally been recommended for this purpose. Albuminous liquids, of which the most appropriate is milk, should afterwards be administered. The excessive local action of nitrate of silver upon the skin, fauces, vagina, etc., may also be checked by salt.

CUPRI SULPHAS.—Sulphate of Copper.

Sources.—Native crystals of sulphate of copper, as well as a solution of this salt, are found in the waters of copper mines. It is also obtained by roasting the native sulphuret of copper, and sometimes by the direct action of sulphuric acid upon the metal.

Properties.—It is generally met with in large crystals of a beautiful dark blue color, which have a styptic, metallic, and very disagreeable taste, and a brassy smell when rubbed. It is soluble in one-third of its weight of cold water, and effloresces when exposed to the air. Of its *incompatibles* the following may be mentioned as the most important: the alkalies, earths, soluble carbonates, salts of lead, acetate of iron, and astringent vegetable infusions and tinctures.

Action. *On Animals.*—Schubarth found that half a drachm of this salt given to a dog produced violent vomiting and straining, followed by exhaustion, but the animal was well in twenty-four hours.[1] Much smaller doses have proved fatal to dogs. In an experiment of Drouard twelve grains caused the animal's death. Large doses, indeed, are fatal in a very short time, if vomiting is prevented by ligation of the œsophagus. Besides vomiting, and attempts to vomit, the other symptoms noted are convulsions, great insensibility, and paralysis. After death the only lesion discovered is more or less inflammation of the stomach. When the other viscera

[1] Wibmer, Wirkung, etc., ii. 260.

are subjected to the action of hot water and nitric acid, appropriate tests reveal the presence of copper.[1]

On Man.—Applied to mucous membranes generally, or when taken internally in small doses, as a quarter of a grain, several times a day, its action may be regarded as astringent and tonic. Applied to a wound or ulcer, that is to say, therapeutically, it coagulates the albumen by combining with it, in the manner of an astringent, but it has no destructive or caustic action upon the tissues themselves, when given in medicinal doses. Its action upon the stomach, in larger doses (5 to 15 grs.), has much in common with that of sulphate of zinc, common salt, alum, mustard, etc.; in other words, it is an irritant emetic. Like theirs, its action is extremely prompt and rapid, and it leaves no nausea nor malaise behind it. Clarus regards it as acting less upon the mucous coat of the stomach than upon the pneumogastric nerve.[2] Still larger or poisonous doses (ʒss or more) are by no means always fatal. In a case in which five drachms were taken, the symptoms were indeed severe, but under the influence of diffusible stimulants the patient recovered.[3] Another case is recorded in which an ounce was swallowed, with suicidal intent, after a glass of rum punch. The patient refused to take an emetic, but nevertheless recovered.[4] In a third case a woman swallowed two hundred and thirty grains of sulphate of copper dissolved in a glass of water. She suffered great pain, hiccoughed, vomited, etc., but in a few days recovered.[5]

The symptoms of acute poisoning by this substance are, according to the dose, and the powers of the constitution, headache, insensibility, convulsions, tetanus, contracted features, small pulse, cold skin, colic, vomiting, which is generally violent, sometimes suppression of urine, and occasionally jaundice. Recovery is usually rapid and complete. Sometimes, but rarely, there remains for several weeks a liability to vomiting, with colic and diarrhœa, extreme debility and more or less emaciation. There is a form of enteritis marked by diarrhœa, tenderness of abdomen, vomiting, and sometimes bloody stools, which is produced by exposure to the emanations of copper and by the ingestion of its salts (the acetate especially) mixed with the ordinary food; but such effects are not traceable to the sulphate, of which several grains a day have been taken for a period of one or two months, or even much longer, without any constitutional disturbance.[6]

When death occurs soon after a poisonous dose of this substance has been swallowed, the only perceptible lesion is an intense redness of a portion of the gastric mucous membrane, and more or less inflammation of the œsophagus and small intestine. When the dose has been very large, and fatal after a considerable interval,

[1] Danger and Flandrin, Annales de Thérap., i. 254.
[2] Arzneimittellehre, p. 880.
[3] Taylor, Med. Jurisp. (Am. ed.), p. 370.
[4] Dierbach, Neuste Entdeck, iii. 698. [5] Bull de Thérap., lxxx. 135.
[6] Blandet, Journal de Méd., 1845, p. 68.

ulceration and sloughing of the bowels have been found, and even perforation of the peritoneum.

Uses. *As an Emetic.*—"It has been recommended for its rapid operation as an emetic, but sulphate of zinc is quite as prompt in its action, without involving a risk of permanent injury to the stomach." This statement of Richter,[1] which also has been repeated by Christison, has no foundation in fact. We can discover no case in which emetic doses of sulphate of copper have proved in any degree mischievous, and do not hesitate to recommend it as the equivalent of sulphate of zinc in cases of *narcotic poisoning*, or whenever vomiting without nausea is to be excited.

Croup.—It was first used in Germany as an emetic in this disease by Hoffmann, of Hesse, in 1821. Kopp, who soon afterwards published a statement of its efficacy,[2] was followed by a host of writers equally loud in its praise, of whom may be mentioned Zimmermann, Fielitz, Gittermann, Serlo, Malin, Droste, Wunderlich, Hankel, Nyborg, Camerer, Schlesier, Schwabe,[3] and Aberle.[4] A very large proportion, how large cannot certainly be known, of their cases, were of spasmodic croup, and prove conclusively, it may be incidentally remarked, that nauseants are not essential to produce the resolution of that disease. But all of the cases were not of this description. Not a few were examples of pseudo-membranous laryngitis. But leaving those just referred to out of the question, allusion may be made to the report of Béringuier,[5] containing five cases, in all of which the pseudo-membranous form of the disease was unequivocal. They all recovered under the use of this substance administered after depletion, which agency, indeed, the reporter considered as a very important preparation for the emetic. Béringuier gave two grains of the medicine, and repeated this dose in five minutes, unless vomiting occurred sooner. Sometimes he increased the dose to four grains. In no instance were any bad consequences produced by it, and particularly no irritability of the stomach. Godefroy[6] reported seventeen cases of "croup," ten of which were unquestionably of the pseudo-membranous form. They all recovered under the use of the emetic, together with depletion and cauterization of the pharynx. Marel also reported[7] eight cases of pseudo-membranous croup, six of which recovered after the use of emetic doses of sulphate of copper, and Missoux alleged that he lost but two out of twenty-two cases in which the medicine was administered in five grain doses.[8] Kissel saved twelve out of fourteen cases of this disease, by using an alcoholic solution of the acetate of copper. He maintains that the medicine cures less by its emetic operation than by a specific action in non-emetic doses.[9] It is due to a just appreciation of this subject to state that the testi-

[1] Ausfürlich. Arzneim., iv. 493.
[2] Brit. and For. Med. Rev., i. 568.
[3] Dierbach, op. cit., iii. 699.
[4] Brit. and For. Med. Rev., xvii. 557.
[5] Annales de Thérap., iv. 151.
[6] Bull. de Thérap , xxix. 72, and Journ. des Connaissances, etc., Juill. 1845.
[7] Bull. de Thérap., xxxviii. 327.
[8] Ibid., lv. 555.
[9] Journal für Pharmakodynamik, i. 194, 198.

mony which has been adduced is not wholly uncontradicted. Dr. Hannay[1] states that he made a fair and careful trial of it in six cases, and in all the issue was death. Such of the particulars as are furnished corroborate his general statement, and show that he not only used the remedy faithfully, but conjoined with it, also, depletion and mercurial inunctions. On the whole, it follows, from the above survey of the subject, that sulphate of copper is a valuable emetic in croup whenever emetics can do good, but that it will fail whenever the act of vomiting, vigorously performed, is unable to free the air passages of the concretions that line them.

Diarrhœa.—Elliotson[2] regarded it as superior to every other astringent in chronic diarrhœa. He administered it in pilular form, combined with opium, in doses of from one to three grains three times a day, and given after meals. If taken alone, and upon an empty stomach, he found that it sometimes occasioned nausea and diarrhœa. Pereira employed it successfully for infantile diarrhœa, in doses of one-twelfth of a grain.

Intermittent Fevers.—It is stated, by Hoffmann, Adair, Richter, and Monro, to have been very effectual in obstinate quartan and other agues. Of its use in quartans Chapman says:[3] "I know not a remedy entitled to much greater confidence." He gave it in doses of one-quarter of a grain, combined with opium, three or four times a day. It has also been given in *atonic dropsy* and in several *convulsive diseases*, but its value in these cases is far from being ascertained.

Externally.—The most ordinary application of sulphate of copper is to repress the exuberant or flabby granulations of certain *ulcers*, and to stimulate such as are slow to granulate. It is much used for syphilitic ulcers of this character, and also for phagedenic ulcerations. In chronic forms of *conjunctivitis*, with a relaxed and flabby condition, and particularly with a granular state of the membrane, the application of a crystal of sulphate of copper, or of the pencil described below, to the ocular surface of either eyelid is often of great service. In solution it has also been used to arrest the development of purulent ophthalmia. Dr. B. H. Coates[4] found this remedy, "beyond all comparison," the best for "*gangrene of the mouth.*" The epidemic which Dr. C. describes was one of *ulcerative stomatitis;* but the value of the application in gangrene of the mouth also is attested by Dewees, Drs. Condie, J. F. Meigs, and others. In the same affection, and also in simple *sore-throat*, a nebulized solution of sulphate of copper may be employed with marked advantage. Dr. Coates used the following formula: ℞.—Cupri sulph. gr. cxx; pulv. cinchonæ ℥ss; aquæ ℥iv. S.—To be applied to the ulcerated parts twice a day. Sulphate of copper may also be used for *superficial ulcers* of the mouth, and especially for those occasioned by mercury; to arrest the flow from *bleeding surfaces*, such as ulcers or wounds in spongy tissues; as a wash in *gutta rosacea* (gr.

[1] Lond. Med. Gaz., July, 1840, p. 583.
[2] Med.-Chir. Trans., xiii. 451.
[3] Therapeutics, ii. 451.
[4] N. Am. Med. and Surg. Journ., ii. 20.

ij to ℥j); dissolved in whiskey, as a wash in *alopœcia;* to correct *foul odors* arising from gangrenous parts; as an injection in *gleet* and chronic *leucorrhœa*, etc.

Administration and Dose.—This medicine is administered internally either in substance or in solution, but the former mode is preferable. As an emetic from *two* to *fifteen* grains in powder, mixed with white sugar, may be given every ten minutes until vomiting takes place. As a tonic or astringent, from a *quarter* of a grain to *two* or *more* grains may be prescribed, in pilular form, three or four times a day. For external use solutions are chiefly employed. They may contain from *one* to *ten* or *more* grains to the ounce of water. Pencils of sulphate of copper may be conveniently made by fusing together two parts of sulphate of copper and one part of alum (sulphate of aluminium and potassium).

ZINCI CHLORIDUM.—Chloride of Zinc.

Preparation and Properties.—This substance is prepared by dissolving zinc or its oxide or carbonate in hydrochloric acid, and then filtering the solution and evaporating it to dryness. It is at first a grayish white, semi-transparent, and gelatinous substance, but, if fully dried, becomes solid and pulverizable. It deliquesces on exposure to the air, is soluble in water, alcohol, and ether, and unites with both albumen and gelatin. It has an acrid and metallic taste.

Action.—In small and properly adjusted doses chloride of zinc is said to act as a stimulant and tonic to the nervous system, and to increase the urinary secretion. In large doses it is a powerful irritant poison, occasioning pain in the stomach, nausea, vomiting, anxiety, quick, short breathing, a small, rapid pulse, cold sweats, syncope, and convulsions.[1] A man swallowed an ounce of "Morell's solution of chloride of zinc." No corrosive action was exerted on the mouth or throat, but soon severe pain was felt in the stomach, and vomiting, excited by oil, etc., took place freely. The pain spread over the abdomen, and became excruciating, and was accompanied by cramps in the legs; the pulse at first was but slightly altered, but afterwards grew weak and frequent as collapse proceeded; the face and extremities were purplish, the pupils were dilated, and the sight impaired, but the mind remained clear until death, which took place without a struggle nearly eight hours after the poison had been swallowed. No lesion of the pharynx or œsophagus was found; the cardiac two-thirds of the stomach had its mucous membrane softened and disintegrated; in the pyloric third the membrane was tough and condensed, and of a dull buff color, as if tanned by the chloride. The heart was distended with diffluent blood.[2] In a second case a lady swallowed about two fluidounces of "Burnett's disinfecting fluid." She presented very

[1] Wibmer, Wirkung, etc., v. 451. [2] Beale's Archives, i. 194.

nearly the same symptoms as in the case just related, and died in seven hours and a half.[1] About an ounce and a half of the same fluid was taken by a woman who likewise presented almost identical symptoms, except that her lips and tongue were blistered, and she was violently purged. She died in fourteen hours, and on examination of her body the mucous membrane of the lips and tongue was found abraded, and that of the œsophagus nearly destroyed; the mucous membrane of the stomach was of an ash color, and its organization entirely destroyed; the other coats had a leathery consistence. Although the autopsy was made in very hot weather, and forty-eight hours after the patient's death, the body showed no sign of decomposition, and had no disagreeable odor.[2]

Applied *externally*, it is, when undiluted, a powerful corrosive irritant, but according to Hancke, it differs from several other caustics—those, for example, prepared with corrosive sublimate and arsenic—in producing but little pain. Its action is thus described by Ure. Soon after it is applied a sense of warmth is felt in the part, which is quickly followed by severe burning pain, which continues for seven or eight hours, and subsequently by the death of the cauterized tissue. It forms a whitish eschar, which separates in the course of from eight to twelve days.[3] This caustic, says Vogt,[4] is useful, because, if absorbed, it can do no injury, and it is therefore appropriate when large abnormal growths are to be destroyed. Nor does it produce a foul slough like the chloride of antimony, the caustic alkalies, etc., nor an inflamed sore with profuse discharge, but it leaves behind a clean granulating surface, discharging healthy pus, and tending rapidly to cicatrization.

Uses.—This agent has been used *internally* in a great number of constitutional cachexiæ—syphilitic, scrofulous, scorbutic, cancerous, etc.; but the danger of its operation should dissuade from employing a remedy of such inferior, and, indeed, questionable value.

Externally it has been recommended by Vogt as a very efficient application to *ulcers* in persons of a torpid and cachectic constitution, or whenever they present a foul and flabby look, and discharge an abundant thin and acrid matter. Canquoin used it extensively to remove *cancerous* tumors, etc., and he claims to have cured four-fifths of one hundred and twenty-six cases by its means. He made use of a paste of various strengths, containing one part by weight of the chloride to two, three, four, or five parts of flour.[5]

[1] Cousins, Times and Gaz., Oct. 1862, p. 404. [2] Lancet, Sept. 1864, p. 267.
[3] Lond. Med. Gaz., xvii. 571. [4] Lehrbuch, 3tte Aufl., i. 335.
[5] M. Mayet has proposed the following modification of Canquoin's original formula, for which he claims the advantage that it does not produce a readily deliquescent paste: Take of chloride of zinc, 8 parts; oxide of zinc, 1 part; wheaten flour, dried at 212° F., 7 parts; water, 1 part. Mix the oxide of zinc and the flour, dissolve the chloride of zinc in the water, and add the mixture of flour and oxide of zinc. Pound the paste in a mortar for ten minutes. (Bull. et Mém. de la Soc. de Thérap., ii. 160.) Mr. Weeden Cooke devised a plan by which the action of chloride of zinc can be strictly limited. He saturates lint with the deliquesced salt, dries it as far as possible in the air, and preserves it in a wooden or pasteboard box. The lint, when used, must be cut with scissors which can be spared, since it ruins metallic instruments. Its great convenience consists in this, that

This, when formed into disks proportioned in size and thickness to the extent of the diseased part, was allowed to produce an eschar which varied from a line to more than an inch in thickness, according to the strength of the paste, the duration of its contact with the morbid tissue, and the firmness of the latter. After separation of the eschar a stimulant resinous plaster was applied. According to its proposer, the advantages of this treatment are, that the action of the caustic is limited to the diseased parts, that it is less painful than the arsenical paste, that it destroys the offensive smell of the sore, and that the wound left by it heals rapidly.[1] Superficial cancerous ulcers have also been treated successfully by Lawrence, McClintock, and others, with this caustic.[2] In 1857 and 1858, the attention of English surgeons was drawn to the operation of a secret remedy proposed as a cure for cancer by Dr. Fell, an American physician, and which turned out to be chloride of zinc mixed with an inert vegetable powder. After attracting a great deal of notice, and having been thoroughly put to the test, the same conclusion was arrived at as on other occasions of its use, viz., that the special efficacy attributed to it is illusory, that it does not act upon the skin while the epidermis remains whole, that its action is not complete in less than one or two days, that it often produces such intolerable pain that patients of the greatest fortitude are unwilling to submit to a second application of it, and that no more than the knife does it afford security against a reproduction of the disease.[3] These statements, and those already given, are doubtless equally exaggerated. In spite, however, of the real value of this caustic in cancerous disease, it is certainly much less used, and is probably much less effectual and prompt in its action, than the arsenical paste. It has been applied to remove other abnormal growths. Calloway employed it for the destruction of *nævi materni*, and Hancke, of Breslau, for these tumors, for *fungus hæmatodes*, *malignant pustule*, etc.

Mr. Campbell De Morgan[4] advocated the use of chloride of zinc in the treatment of cancer, not as an escharotic for the removal of the morbid mass, but after its extirpation with the knife, to destroy the germs which the surgical operation has not removed. He thinks it probable that the recurrence of cancer in its original seat or in remoter parts is due alone to its imperfect removal by the knife, and not to a special diathesis, which he rejects as an unproved hypothesis; and that, consequently, if a substance capable of destroying all of the cancer germs, in the neighborhood of the principal tumor operated upon, can be applied to the wound, the danger of a relapse will be materially diminished. His observa-

the smallest pieces may be used, even to a wart or pimple ; or to parts, such as the eyelids, to which it would be almost impossible to apply the paste. Its practical success is stated to have been complete. (Practitioner, i. 182.)

[1] SOBERNHEIM, Handbuch der Pract. Arzneim.

[2] WALSHE, On Cancer, p. 219.

[3] Times and Gaz., June, 1857, p. 573.

[4] Brit. and For. Med.-Chir. Rev., Jan. 1866, p. 201.

tions, as far as their limited number can go, appear to justify this anticipation. Many cases are reported which seem to favor this opinion, for in some of them the patients appear to have lived much longer than they would have done after the operation by the knife. Such examples are reported by Mr. Maunder[1] and by Mr. Lawson.[2] They confirm the statement of Canquoin that the action of the chloride of zinc is remarkably local, its action terminating at the point of its contact with the tissues. When a solution of from twenty to forty grains of the salt in an ounce of water is applied to a raw surface, it causes at first a general oozing of pinkish blood, which continues as long as the application is repeated. The tissues acquire a peculiar pulpy condition, which is, however, very superficial. There is no decomposition in the ordinary sense, and therefore neither the stale nor fetid smell exhaled by suppurating wounds, nor the usual liability to erysipelas; the edges of the wound preserve their natural color and do not swell, and their union is more speedy than when suppuration is established. These results, which were observed in the treatment of various wounds and sores, as well as after the operation for cancer, appear to confirm the statements of Vogt and others, which have already been quoted. Mr. De Morgan claims that when *wounds* and *abscesses* especially involving joints occur in scrofulous persons, or in others of feeble vitality, the tendency to decomposition in the discharges and the consequent danger of septicæmia and of tedious reparation may be greatly lessened by sponging the secreting surfaces thoroughly with a solution of chloride of zinc, forty grains to the ounce.[3] A solution of this substance has also been used as an injection in *gonorrhœa.*

Administration.—If used internally, a solution may be made of half an ounce of chloride of zinc to three fluidounces of spirit of sulphuric ether, and prescribed in doses of from four to eight drops twice a day.

For external application, when a powerful caustic operation is sought, the methods of Canquoin and others already indicated are the best. When a more superficial action is desired, the concentrated solution may be applied by means of a brush until it excites a burning pain. In the case of indolent sores, applications subsequent to the first should be made with a weaker solution.

ANTIMONII ET POTASSII TARTRAS, vid. *Emetics.*

[1] July, 1870, p. 61.
[2] Trans. Clin. Soc., v. 1.
[3] Trans. Clin. Soc., i. 138.

VEGETABLE IRRITANTS.

SINAPIS ALBA.—WHITE MUSTARD.[1]

SINAPIS NIGRA.—*Black Mustard.*

Description.—The seed of *Sinapis nigra* and *S. alba*. These are annual plants, and both of them natives of Europe. They are, however, cultivated in this country. Black mustard seeds are small, globular, rugose, of a reddish or blackish-brown color without, and yellow within, inodorous when whole, but when crushed, exhale a strong and pungent smell; their taste is hot, bitterish, and somewhat unctuous. White mustard seeds are larger, of a yellowish color, and a less biting taste.

History.—Hippocrates[2] speaks of mustard as being hot and purgative, but apt to produce incontinence of urine. Dioscorides[3] recommends it to be chewed to purge the brain of phlegm, and to be used as a gargle with honey and water for inflammation of the throat, and as a sternutatory in epilepsy and hysteria. He directs it to be applied to the shaven scalp in lethargy, as a rubefacient cataplasm mixed with the pulp of figs in sciatica, and for other pains, and generally as a counter-irritant. According to this writer, it promotes the growth of hair in bald places, acts as a cosmetic, and cures obstinate eruptions of the skin when mixed with ointments or with vinegar. It is taken in substance or mixed with liquids for intermittent fevers; it is also added to vesicating plasters and to those for scabies. Bruised and applied upon a fig behind the ears, it cures deafness and *tinnitus aurium*. Its juice, with honey, is recommended as a remedy for roughness of the eyelids and weakness of sight.

Archigenes, who lived in the reign of Trajan, wrote a treatise on the external use of mustard (*de sinapismo*), extolling it as a remedy for nearly all chronic diseases. He directed its application to the head in mania and epilepsy, and the use of suppositories containing it in paralysis of the rectum. He was also acquainted with the power of vinegar to weaken the action of mustard, a fact that Aëtius also alludes to in these words, "*Acetum enim sinapis vim discussit.*" The first-named writer directed the medicine to be applied upon figs, or, if the skin was very sensitive, upon bread, and ordered the part to be first sponged with hot water, when a rapid action of the sinapism was desired. Cælius Aurelianus alludes to

[1] Mustard, from *mustum ardens*, because it was formerly manufactured from *must*, or new wine, and the powdered seeds of the plant.—MÉRAT.

[2] De Dietâ, ii. 25.

[3] Mat. Med., ii. 148.

the emetic properties of mustard, and advises it to be given with bread as a vermifuge.[1] Ruffus recommends the seed of mustard as a laxative.[2] Aretæus speaks of it as a stimulant and revulsive in chronic affections of the lungs, in tonsillitis, in headache, in apoplectic states of the brain; as an emetic in epilepsy; and of its use in poultices to hasten the discharge of chronic pleurisy when the fluid points externally.[3] In his Commentaries, Matthiolus directs a poultice of bruised mustard seed, flour, and vinegar, as a remedy for the bites of serpents and scorpions, and an infusion of the seeds to relieve poisoning by mushrooms. He recommends it also as a palliative for asthma, as diuretic, and as emmenagogue.

Action. *On Animals.*—The peculiar action of mustard depends upon the acrid oil developed in its seeds by their admixture with water or by the process of distillation. The effects of this oil may be illustrated by the experiments of Mitscherlich, from which it may be inferred that—

1. Essential oil of mustard is a virulent poison. A drachm of it destroyed a rabbit in two hours, and half an ounce in fifteen minutes. Of all the oils hitherto tried, it is the most poisonous, even more so than that of bitter almonds.

2. It is absorbed; for its odor was perceptible upon the breath and in the peritoneal cavity of the animals opened immediately after death. The smell of the urine, on the other hand, was peculiar, and somewhat like that of horseradish.

3. The stomach and bowels were but slightly inflamed, but the vessels were gorged with thick and dark blood. The irritability of the heart and the other muscles continued for an unusual time after death.

4. The actual symptoms of the poisoning were these: Great frequency of the heart's action, speedy loss of sensibility and muscular power, feebleness of the heart's pulsations, difficult respiration, repeated convulsions, great insensibility, coldness of the external parts, and death.

On Man.—Mustard seeds taken whole, and in doses of a teaspoonful three or four times a day, have a laxative action on the bowels, and are discharged without perceptible change. In a fatal case of peritonitis, the cause of the attack appeared to be a mustard seed lodged in the appendix vermiformis. That such an event is one of not improbable occurrence is shown by the numerous instances in which small shot, cherry-stones, etc., have occasioned a similar accident.

Powdered mustard produces a peculiar prickling and lively burning when applied to the tongue, and moderately large quantities excite similar sensations in the throat and stomach. It promotes the digestion of food, but an habitual use of it, as of all stimulant condiments, enfeebles the stomach. In large quantities, and diffused through water, it serves as a prompt and efficient emetic, but

[1] Strumpf, op. cit., ii. 67. [2] Adams, Comm. on Paul. Æginet., iii. 264.
[3] Comp., lib. i. cap. 2 and 10; lib. ii. cap. 1, etc.

care must be taken to evacuate the dose completely from the stomach, lest it cause inflammation of that organ. Van Swieten relates a case of neglect of this precaution, which terminated fatally on the third day.

In the form of sinapism, mustard produces, after the lapse of three or four minutes, an acute prickling and stinging pain, which afterwards grows burning, and seems to penetrate deeper and deeper. It has been compared to the pain of a red-hot iron held at a little distance from the body. A sensation is then perceived as if the part were being constricted or compressed, and is more tolerable than the former, but after a few minutes the burning pain revives and speedily grows insupportable. From the moment when pain is first felt, the skin becomes red and rapidly inflames; this state augments, indeed, even after the removal of the sinapism. The redness generally remains for several days, after which the cuticle usually exfoliates; but the part continues to be very sensitive for a much longer period. The time necessary for producing these effects varies with the sensibility of the skin, but they are usually developed by less than half an hour's use of the plaster. Its longer contact vesicates the skin, and is apt to produce ulcers which are singularly difficult to heal. Sometimes the skin remains permanently discolored. Freshly-powdered mustard acts more rapidly, but not more efficiently, than what has been prepared for several months. As was remarked, the rapidity and the degree of action of sinapisms are proportioned to the delicacy of the skin to which they are applied. Hence the caution demanded in using them on females and young children. Their mischievous effects upon the latter have been pointed out by Valleix,[1] who remarked that the pain caused by them may become dangerous at an age when all strong impressions upon the nervous system are apt to be followed by cerebral excitement. Here the benefits of counter-irritation are purchased at a ruinous price. In his little work on Infant Therapeutics, Beck has also dwelt upon the dangers of incautiously using these remedies in young persons, dangers which he illustrates by a case in which suppuration, gangrene, and death were produced by a mustard poultice applied by mistake to the swollen glands of a child's neck. The action of sinapisms is also proportioned to the vital activity of the part to which they are applied. In collapse, in low states of the system, or during a chill, they may fail to exert any influence whatever.

Some curious phenomena developed by general baths containing mustard have been pointed out by Trousseau and Bonfils.[2] At a temperature of 86° F., the patients experienced wandering chills in the loins, the back, the abdomen, and limbs, followed by a decided sense of coldness in the loins and abdomen, and afterwards by shuddering and shivering, slight twitching of the lips and limbs, and chattering of the teeth. The expression of the countenance changed, and the patients complained of suffering from cold. Meanwhile

[1] Bull. de Thérap., xxvi. 184. [2] Ibid., lv. 25.

the skin remained at the temperature of the bath, and the pulse was but slightly accelerated. By degrees the skin gave evidence, by its redness, of the irritant action of the mustard, yet without any sensation of heat until after the patient had withdrawn from the water. Then reaction was established, and general heat of the surface with stinging and burning sensations was experienced.

Oleum Sinapinum.—Volatile oil of mustard was formerly procured in an impure state by expression merely, and was employed as a rubefacient in painful and spasmodic disorders. It seems to have been first used for medicinal purposes in a separate state in 1820, at Cadiz, and some years afterwards (1831) a saturated solution of the oil in water was employed. This oil is usually obtained by distillation from black mustard seed after the removal of the fixed oil by pressure. Water seems to be necessary for its extraction. This fluid is regarded as causing by its presence such a reaction between the myronate of potassa and the myrosyne of the seeds as results in the production of volatile oil. White mustard seed contains myrosyne, but not the myronate of potassa; it has, however, among its constituents a substance analogous to the latter, which develops an acrid principle of feebler power, but of the same nature as that contained in the black variety. It is essential to the development of these acrid products that a low degree of heat should be employed. For hot water, alcohol, and the acids, equally prevent their formation by coagulating the myrosyne.

Volatile oil of mustard is of a white or lemon color, and extremely acrid and pungent, exciting the secretion of tears when smelled. A single drop of it upon the tongue causes an insufferable burning pain, which extends to the nose, throat, and stomach. Upon the skin it acts promptly and severely as a caustic. Provost applied some of it to the shaven skin of a dog, and produced signs of extreme suffering, followed by the formation of a large blister.[1]

The fixed oil of mustard is mild, inodorous, somewhat thicker than olive oil, and of an amber color. Its sp. gr. is 0.917. It forms a very hard soap, and acts as a purgative in doses of two ounces.

Uses.—In that form of gastric disorder known as *atonic dyspepsia*, and which appears to be a simple debility of the digestive organs, due to inadequate circulation and secretion, mustard is advantageous both as a condiment and when taken in the whole seed. The latter is perhaps the preferable form when, as generally happens, the bowels are constipated. With their restoration to a healthy action, the flatulence, oppression, nervousness, etc., usually disappear. In this manner certain forms of nervous disease, and hypochondriasis particularly, have been greatly benefited. Juariz relates that a Spanish physician, during convalescence from a gastric fever, suffered from a severe *hiccough* which refused to yield to any of numerous remedies which were successively tried. He had ordered flaxseed tea for a drink, but by mistake an infusion of mustard was given

[1] Wibmer, Wirkung der Arzneim. u. Gifte, v. 43.

him, which he drank. The hiccough ceased and did not return. Subsequently he employed the remedy successfully in other cases.[1]

Mustard is one of the most prompt and efficient emetics that can be used, and is peculiarly appropriate where it is desirable rather to stimulate than to depress the system. Such is the case in *narcotic poisoning*, for which this agent should always be employed in preference to the more usual ones. In that stage of *delirium tremens* when a timely emetic will cut short the attack, none is so appropriate as mustard. The late Dr. Joseph Klapp, of Philadelphia, had a large and successful experience in its use, and published striking reports of its efficacy.[2]

In *atonic dropsy*, Mead and others have extolled the virtues of mustard seed; but, except as an adjuvant to other and more active treatment, it is of no value in this affection. An infusion of the seed in cider has more to recommend it in the case in question, and mustard whey may probably conspire with it as a stimulant diuretic.

Chronic *pulmonary catarrh*, attended with asthmatic symptoms, is said to be benefited by the use of mustard seed. The evidence upon this point is not, however, conclusive. Numerous other remedies have more in their favor.

It has already been mentioned that mustard was successfully employed by the ancients in certain *cutaneous disorders*. Julia de Fontenelle made use of water impregnated with the essential oil of mustard for the same purpose, and he reports twelve cases of *scabies* as having been cured by its means.[3] A strong opinion in favor of the depurative action of this remedy is expressed by Trousseau, who asserts that, by continuing its use for a long time, he has cured, or put in the way of cure, cases of cutaneous disease and of *rheumatism* which nothing else benefited.

But it is as an *external irritant* that mustard is best and most advantageously known. It may be used, like other local stimulants, to excite feeble parts, or to moderate excessive local action by withdrawing stimulus. The direct and simple stimulation of mustard is often serviceable by arousing the whole system from torpor or exhaustion, as in *swooning*, the insensibility of *hysteria* and its allied states, and in the *coma* of febrile or other affections in which the brain seems to be oppressed. It is familiarly employed as a domestic remedy in warm baths to arrest the *convulsions* of children; and in foot-baths to allay headache, relieve congestion of the brain, promote the *menstrual discharge*, and arrest incipient catarrhs. Dr. Laurent, physician to an insane asylum in France, speaks in strong terms of commendation of the use of general mustard baths in cases of hysterical and other forms of *insanity*, especially those accompanied by great prostration. The water of the bath should have a temperature of from 77° to 82° F., and contain about three ounces of bruised or ground black mustard seed. The

[1] Bull de Thérap., lxxviii. 41. [2] Phila. Med. Recorder, i. 462, 478.
[3] MÉRAT and DE LENS, Dict. de Mat. Méd., vi. 354.

duration of the bath should not exceed half or three quarters of an hour. The first sensation experienced is one of general tingling of the skin, which is followed by a sense of coolness. On leaving the bath the skin is red, and feels glowing; the mental excitement has abated, and generally there is a tendency to sleep.[1] The suggestion and use of mustard in poultices and baths for the purposes indicated was earlier made by Dr. S. Newington,[2] who first experienced in his own person their soothing and hypnotic effects. A large mustard poultice made with one part of mustard flour to ten of flaxseed meal and applied to his own abdomen occasioned so profound a sleep that his assistant supposed him to be in a narcotic stupor. In other cases a long, thick towel saturated with mustard water (made by infusing two handfuls of mustard flour, tied in a cloth, in warm water, and squeezing the ball when thoroughly soaked) was wrapped around the loins of the patient and covered with water-proof cloth. In others, again, the hip bath or the full bath was employed. These various grades of the application were made according to the several degrees of excitement in the cases to be treated, and their effect was uniformly to allay excitement, and often to promote sleep where all the usual hypnotics had failed of their effect. This latter influence must be attributed to various causes, sometimes to the palliation of pain, sometimes to the substituted and not painful sensation, but also, it may be supposed, to the derivation from the brain by which that organ is placed in a condition favorable to natural sleep. Certain it is that the deep sleep produced in Mr. Newington's experiment is often witnessed as an effect of sinapisms, and we have more than once known tedious and painful sores produced by them because the patient fell asleep during the first stages of their operation.

When the action of a part is morbidly diminished, the temporary application of mustard may be useful; as when an eruption is slow to make its appearance, or has receded after having broken out; when retrocession of specific inflammatory action to a vital organ takes place, as in *gout* and *rheumatism;* when the skin where *leeches* are to be applied is deficient in vascularity; or, finally, when a part becomes *atrophied* from disease or want of use, as the muscles of the limbs, for example.

But mustard is most generally used as a counter-irritant. Its speedy and temporary action is invaluable for relieving local pains of a *neuralgic* character, and those even of a congestive or an inflammatory origin, provided that the inflammation be in its nascent stage, or of moderate activity. Hence in subacute and chronic *rheumatism* of the muscles and joints, in rheumatic *toothache*, *earache*, etc., in *neuralgia* produced by cold, in *pleurodynia*, *flatulent colic*, spasmodic and humid *asthma*, *muscular cramps*, *congestion of the brain*, arrested *catamenia*, the various forms in which mustard may be employed find a constant and successful application. A most valuable application of this medicine is to the treatment of incipient bowel complaints, including *diarrhœa*, *cholera-morbus*, *epidemic*

[1] Bull. de Thérap., lxxiii. 45. [2] Lancet, June, 1865, p. 621.

cholera, and *dysentery*. In all of these affections, so long as the predominant morbid element is congestion, it may be palliated or even neutralized by a mild but general action upon the skin, such as a warm mustard hip or general bath, or in the milder of the affections named, a mustard cataplasm or fomentation will exert. There is no doubt that in Asiatic cholera this treatment, besides the appropriate internal remedies, will not only go far to render them efficient in the early stage of the disease, the only one in which treatment of any kind can be relied upon, but that even after profuse evacuations and the cyanosis which results from them, nothing offers a fairer hope of quickening the cutaneous circulation and retarding the intestinal flux, provided the capacity for reaction is not extinct.

Administration.—Mustard does not lose much of its activity by keeping. Lukewarm or cold water does not, like hot water, impair its power, but vinegar has this effect very decidedly. Hence, when a sinapism of moderate activity is required, it may be prepared with vinegar, instead of being, as it usually is, diluted with wheat or rye flour. Even strong acetic acid mixed with mustard makes a weaker sinapism than if water is employed; still, such a preparation as the former may have advantages when a very speedy impression is required. Trousseau and Blanc state that white or English mustard is not so much impaired by vinegar as the dark variety is;[1] but this may perhaps be explained, according to Pereira, by the circumstance that English mustard is frequently adulterated with pod pepper, which is a powerful rebefacient. The irritant effects of mustard may be relieved by narcotic fomentations, by cold water, by simple unctuous applications, by lead cerate, or, still better, by the ointments of belladonna, stramonium, etc. One of the best palliatives is linimentum calcis.

Of the seeds, a teaspoonful to a tablespoonful may be taken two or three times a day. The *infusion* of mustard is prepared by adding from gr. cxx to ℥j of the flour to a pint of lukewarm water. *Mustard whey* is made by adding to a pint of milk and a quart of water an ounce and a half of bruised mustard seed. The mixture is boiled until it is curdled, and is then strained. A wineglassful may be given every hour or two. The *sinapism* or mustard plaster is made by adding cold or lukewarm water to a sufficient quantity of mustard and wheaten or rye flour, and stirring until a thick paste is formed. This is spread upon linen or other convenient substance, and applied to the skin. It is well to interpose a piece of gauze between the plaster and the body, in order to prevent the former from adhering. If it does not produce pain or redness within a quarter of an hour, a stronger application should be made. When it is removed, the skin underneath should be washed with tepid water. When sinapisms are applied to persons in a state of insensibility, the skin should be examined from time to time to

[1] Archives Gén., xxiv. 77.

secure it against excessive irritation.[1] The *mustard cataplasm* is an ordinary poultice with which mustard has been mixed; it is intended to produce a feebler but more prolonged action than the sinapism. *Mustard leaves*, as they are called, are formed of oblong pieces of paper covered with a thin layer of mustard, which is made to adhere to the paper by means of a solution of caoutchouc in sulphide of carbon. This varnish does not diminish the porosity and therefore not the absorbing power of the mustard, so that when the leaf is soaked for a few seconds in water it is ready to be applied. Other procedures are also employed for making mustard leaves. *Sinapised pediluvia* are formed by adding a sufficient quantity of the flour of mustard to an ordinary foot-bath. A tablespoonful may be stated as the average quantity required. When pediluvia are used for their stimulant effect they should be as warm as can be borne; but when employed as derivatives, especially from the head or chest, they should not have a temperature much exceeding that of the blood, or about 100° F. The *ethereal oil* of mustard has been prescribed internally in an emulsion. The dose is from $\frac{1}{12}$ to $\frac{1}{4}$ of a drop several times a day. The oil may be used externally as a rubefacient in the proportion of twenty-four drops to an ounce of alcohol, or of five or six drops to a fluidrachm of oil of almonds. It may be applied by friction or by means of a rag saturated with either of the mixtures mentioned. Care must be taken to proportion the dose to the delicacy of the skin, and to apply it in a very diluted state only to the face or neck.

CAPSICUM.—Capsicum.

Description.—The fruit of Capsicum annuum, and C. fastigiatum, and of other species of Capsicum. Cayenne Pepper is the fruit of *Capsicum annuum*, a native plant of South America, and one of the natural family of Solanaceæ. It does not possess any qualities, however, which illustrate its botanical affinities. This plant bears a pendulous pod-like berry, of a bright red or orange color, containing seeds; when dried and ground it forms the Cayenne pepper of commerce. As many as twenty-five species of capsicum have been described, which possess in a certain degree the qualities of that under notice. It is maintained by some writers that the ancients were acquainted with this plant, but the grounds of their opinion and for supposing capsicum to be of Asiatic origin are believed to be untenable. It was first known in Europe early in the sixteenth century, and was brought thither from the then newly-discovered Western World.

Properties.—The odor of powdered capsicum is pungent and somewhat aromatic; its taste bitterish, fiery, and very persistent. These qualities depend upon a peculiar principle, *capsicin*, which

[1] "Verum ne pustulas vulneraque efficiendo periculum inferat, frequenter detrahendum est cataplasma."—Aretæus, De Cur. Morb. Acut., lib. i. cap. ii.

possesses those of the fruit in a remarkable degree. "Half a grain of it volatilized in a large room causes all who respire the air of the room to cough and sneeze." When applied to the skin, capsicum excites redness of the skin, and ultimately vesication. When swallowed in moderate quantities it produces a sense of burning in the throat, and a grateful warmth in the stomach, while it seems to quicken the appetite and the digestive function. It is peculiarly adapted to promote the digestion of vegetable food and to correct its tendency to produce flatulence. Hence, doubtless, it is universally employed as a condiment in warm climates where fruit and vegetables form the chief aliment of the people. In large doses it produces a glow over the whole body and excites thirst, but it scarcely, if at all, quickens the pulse. After the habitual use of this condiment the signs of its local stimulation decline, and are followed by a proportionate debility of the stomach and bowels. Instances may, nevertheless, be frequently met with in which enormous quantities of capsicum are habitually taken without material injury, provided that no serious impairment of the constitution exists. Disciples of the Thompsonian quackery give daily proof of this. A writer[1] states that one of his friends, who had resided for a long time in the East Indies, ate capsicum upon his bread and butter, the layer of pepper being equal to the butter in thickness.

Its stimulant action upon the urinary apparatus entitles capsicum to be ranked among the aphrodisiacs. Very large doses of it produce great derangement of the stomach in persons unaccustomed to use it freely. According to Vogt[2] the symptoms are violent purging and vomiting with severe colic, and even gastric inflammation, to which Richter[3] adds nervous paralysis or debility, disturbance of the brain, intoxication, and vertigo.

Uses.—The properties of capsicum as a condiment, which have already been referred to, may be applied medicinally in many cases of *feeble digestion*, in such, for example, as are distinguished by flatulence and oppression after meals, and especially when symptoms of this description are connected with a gouty state of the system. Numerous writers mention capsicum as a valuable stimulant in low forms of fever, given either alone or in combination with excitants and tonics. Dr. Chapman indeed observes[4] that to seek a general stimulant effect from this medicine involves an incorrect estimate of its properties. The only indication which, in his opinion, it is capable of fulfilling is that of alleviating gastric distress in continued fever. But it undoubtedly does exert an indirectly stimulant action by enabling the stomach to convert appropriate food into nourishment at a time when, owing to its want of this power, the system is threatened with fatal prostration. Combined with turpentine, it increases the power of this medicine to promote or provoke the discharge of flatus from the bowels, and

[1] Dunglison, Mat. Med., ii. 407.
[2] Pharmakodynamik, 3tte Aufl. ii. 616.
[3] Ausfürlich. Arzneim., ii. 179.
[4] Elem. of Thérap., ii. 143.

thus to remove an incidental but often a very serious complication of typhoid diseases.

This medicine has been proposed as a means of curing *hæmorrhoids* by M. Allégre, and, according to a report made to the Academy of Medicine, with much success. It was administered in doses of from seven to forty-two grains.[1] Dr. Buckingham states that he has found the pickled unripe pepper productive of similar results.[2]

Several writers state that capsicum has been successfully given in *intermittent fever*. Bergius prescribed it for this disease in substance and conjoined with laurel berries, and he declares that he frequently saw intermittent fevers cured by its means, and generally without relapse.[3] Mr. Collins[4] and Niemann[5] also employed it with advantage. It forms an excellent adjuvant to quinia in this and other diseases when the stomach is feeble and the digestion imperfect.

The most useful application of capsicum is in the treatment of *tonsillitis*, and particularly of that form which arises in some cases of scarlatina, and is known as cynanche maligna. Incipient simple tonsillitis may often be arrested at the outset by a strong gargle of Cayenne pepper; but if once the disease is fully developed, it is more hurtful than useful. It is also very efficacious in relaxed states of the mucous membrane covering the *uvula* and fauces. The practice of employing it in the ulcerated sore-throat of *scarlet fever* originated with the West Indian physicians, who used very successfully a preparation described below, "for a kind of angina maligna prevailing among the children of St. Vincent, which began with blackness, sloughiness, and ulceration of the fauces and tonsils without fever."[6] Mr. Stephens gave it to four hundred patients laboring under this disease, and it seemed "to save some whose state had been thought desperate." It was also used successfully by Mr. Collins in a disease which appears to have been what is now called *diphtheria*.[7] Kreysig, Headley, Currie, Collins, and others employed the same or a similar preparation in the malignant sore-throat of *scarlet fever*. As children are seldom able to use it in the form of a gargle, the infusion or the tincture of capsicum may be applied to their throats by means of a piece of sponge attached to an appropriate handle.

Capsicum has also been used advantageously for *sea sickness* in the dose of a teaspoonful, given in some convenient vehicle on the first occurrence of nausea.[8] Dr. Lyons, Dr. Kinnear, and others are stated to have treated *delirium tremens* very successfully with large doses of this medicine. Thirty grains of it in a bolus were ordinarily employed.[9] It produces, says Dr. Lyons, a sense of warmth and comfort in the stomach when first taken, allaying the agitation,

[1] Bost. Med. and Surg. Journ , liii. 324.
[2] Ibid., p. 366.
[3] Mat. Med., i. 144.
[4] Wilson on Febrile Diseases, ii. 141.
[5] Richter, op. cit., ii. 181.
[6] Lewis, Mat. Med., ii. 494.
[7] Med. Communications, ii. 363.
[8] U. S. Dispensatory.
[9] Braithwaite's Retros., liv. 69.

debility, and cardiac and epigastric anxiety; and in from one to three hours will be found to produce sleep, from which the patient awakes conscious and convalescent.[1] It is most successful when administered during the forming stage, when there is tremor, sleeplessness, and general distress and anxiety without delirium.[2] It is best administered in a bolus made by mixing twenty grains of powdered capsicum with honey of roses, or simply with molasses. The effects above described have also been witnessed by Dr. Ford, of Washington, D. C.,[3] in cases treated after Dr. Lyons' method. We have long been in the habit of giving patients affected with this disease, concentrated soups seasoned strongly with Cayenne pepper, and have observed that not only was such food retained when less stimulating articles were rejected, but that the nervous symptoms thenceforth began to subside, and that the power of sleeping was recovered. In the advanced stages of *rheumatism* it has also been recommended, and very probably upon good grounds; for in the chronic and non-febrile forms of the disease it is well known that stimulants, both internal and external, have been used with success.

Administration.—Powdered capsicum may be given in the dose of from five to ten grains in the pilular form. An *infusion* made by adding forty grains to half a pint of boiling water may be prescribed in the dose of a tablespoonful. The infusion referred to above as having been successfully used in angina maligna, may be prepared as follows: Take two tablespoonfuls of red pepper and the same quantity of fine salt, beat them into a paste, and add half a pint of boiling water. Strain off the liquor, when cold, and add to it half a pint of very sharp vinegar. Of this the dose for an adult is a tablespoonful every half hour. The extreme acrimony of the preparation renders it difficult to be administered, and its effects upon the throat are very irritating, but when this part is occupied by sloughs the medicine hastens their separation and promotes the healing of the ulcers which remain.

OLEUM TEREBINTHINÆ.—*Oil of Turpentine.* Vid. *Stimulants.*

PIX BURGUNDICA.—BURGUNDY PITCH.

Description.—"The prepared resinous exudation from Abies excelsa." This tree is a native of Europe and Asia, and abounds in the forests upon the northeastern limits of France, in what was formerly the province of Burgundy. The resin is obtained by means of scarifications made in the bark of the tree. It is opaque, brittle, whitish or yellowish, of a weak terebinthinate taste and odor, softens at the temperature of the body, and adheres strongly to the skin.

[1] BRAITHWAITE'S Retros., lv. 59. [2] Ibid. lvi. 68.
[3] Am. Journ. of Med. Sci, Jan. 1869, p. 110.

Action and Uses.—When applied to the skin in the form of a plaster it acts very slowly as an irritant, producing redness or a papular eruption accompanied with a good deal of itching, and sometimes, particularly if the skin be delicate, a vesicular and even a pustular eruption with superficial ulcers. In some persons, and perhaps during certain epidemic constitutions, it occasionally gives rise to an erysipelatous inflammation of the skin.

Burgundy pitch is one of the most useful of revulsive agents, whether it is employed alone, or as the basis of various plasters which are applied in the daily treatment of chronic diseases. It is in fact a popular remedy among the laboring classes for those *rheumatic* affections of the lumbar and other muscles of the back to which persons are peculiarly exposed who work in a stooping posture, and in the open air. Hence the plasters made with it are vulgarly called *strengthening plasters.* Another and scarcely less valuable application of them is in chronic *affections of the chest.* They act very beneficially by diminishing the sputa in chronic bronchitis and in *phthisis*, by preventing to some extent the intercurrent and subacute inflammation of the lungs which hasten a decline in the latter disease, by relieving the neuralgic pains of the chest which are apt to exist at the same time, and by affording some protection against the impression of external cold. In *chronic pleurisy* it is probable that, either in their simple form or rendered more stimulating by the addition of cantharides (*Emplast. Picis c. Cantharide*), they contribute to hasten the absorption of the effusion, as well as to diminish pain. They may be applied between the shoulders, over the sternum, or upon the lateral regions of the chest, and should always be of large size. For other local pains these plasters are of use, but inferior, for the most part, to other rubefacient and anodyne applications. One case, however, is mentioned by Trousseau, of which a passing notice may be taken. *Sciatica*, it is well known, is an extremely rebellious disease, and Trousseau asserts that he has seen it cured by enveloping the whole thigh in a Burgundy pitch plaster, after blisters and the endermic use of morphia had failed. The method was derived from an extra professional source.

In chronic *inflammation of the bowels* the steady counter-irritation of a Burgundy pitch plaster often proves effectual in removing the last traces of the disease; but the application is a difficult one to make upon so movable a surface as that of the abdomen.

To remove a pitch plaster which still adheres closely to the skin, it should first be softened by passing slowly over its surface a warm flat-iron. If, afterwards, a portion of the pitch remains, it may be removed by pressing upon it a linen rag, to which the adhesive material will cling rather than to the skin itself, and the remainder may be washed away with alcohol.

PETROLEUM.—Rock Oil; Coal Oil; Coal Naphtha.

Description.—Petroleum is a liquid derived by natural or by artificial processes from bituminous coal, and, therefore, is to be found wherever this carbonaceous substance is deposited, in various parts of the United States, of which the Western Pennsylvania coal measures are the most prolific, in the West Indies, England, Southern Europe, Egypt, and Asia. It is usually observed after issuing from the earth and spreading itself as an inflammable film over water, and is procured by boring wells in which it rises under pressure, or from which it is drawn by pumping. As thus procured it varies greatly in appearance; the purer portions being transparent, white, or of a light straw color, the less pure being more or less brownish and opaque. Of these varieties of petroleum the first was formerly distinguished as *naphtha;* but this name is now confined to the distilled and purified oil. It is almost destitute of color, smell, and taste, while the crude oil has a strong bituminous odor, an acrid, bitter taste, and an acid reaction. Chemically it is composed of numerous carbohydrogens, as shown by the various specific gravities and boiling points of its constituents, and by their combinations with alkaline bases. Petroleum varies in sp. gr. from 0.668 to 0.825, is insoluble in water, slightly soluble in diluted alcohol, fully so in pure alcohol, ether, and the essential oils, is very inflammable, and burns with a pure white or ruddy flame, according to the degree of its purity. The bitumen from which petroleum is derived, after parting with the greater portion of its oil, is known as *asphaltum.* It is then black and friable, and more or less soluble in water as well as alcohol.

History.—The use of petroleum by the Egyptians for embalming dead bodies is well known, and it appears to have been employed in burning the dead by the Greeks and other nations who observed this rite. It is supposed to have been the chief constituent of the Greek fire. Dioscorides and Pliny refer to liquid and to solid naphtha. The first of these writers speaks of its application in opacity of the cornea; and the Arabians allude to its possessing emmenagogue and diuretic qualities, to its use in (humid) asthma, and for cough, to its vulnerary and anthelmintic powers, and especially to its employment in suppositories to remove ascarides of the rectum. They speak particularly of its use by friction to relieve rheumatic pains, assuage colic and expel flatus, and of its efficacy in bringing on uterine contractions and expelling the dead fœtus.[1] In later times, even during the last and the early part of the present century, similar virtues were ascribed by high authorities to this substance. Especial weight was attributed to it in the cure of

[1] Ebn Baithar, ii. 558.

tapeworm and other forms of verminous disease, and in removing retention of the urine caused by atony of the bladder. It was also credited with signal virtues as an embrocation in paralysis, contraction and stiffness of the joints, atonic rheumatism and atonic tumors, chilblains, etc.[1] Haarlem oil in Europe, and Seneca oil in this country, which enjoy a popular vogue as cures for such affections, are preparations of petroleum.

Action.—A number of cases on record illustrate the action of petroleum when taken in excessive quantities. Generally there is oppression, giddiness, palpitation, faintness, and headache, but no tendency to stupor, or even sleep; in one case frightful tonic and clonic convulsions are said to have occurred, with horrible suffering; but these symptoms were probably due to the patient's terror. It is stated that in another case the pulse fell from 82 to 48, that the pupils were contracted, the skin hot, the respiration hurried, and the voice weak. The quantity swallowed was probably large, since it was taken by mistake for a glass of beer. (Mayer.) A remarkable fact is that there is no spontaneous tendency to vomiting, nor is there usually diarrhœa. In one case only is death said to have resulted, and then it occurred on the twentieth day, with symptoms of "gastro-enteritis." (Lugeol.) In this case "a glass" of petroleum was swallowed, and the primary symptoms were not grave. The alvine dejections may contain petroleum, as proved by their odor and inflammability, and the urine has an odor compared to that of violets and of orris root.[2]

Paraffin, a solid carbohydrogen, obtained by distilling cannel coal, is a white crystalline solid, resembling white wax. The workmen engaged in its manufacture have the skin of their limbs habitually exposed to the contact of the coal and its products, and suffer in consequence thereof a red papular eruption, which appears to occupy the hair follicles, covering the skin with nodules, each of which presents a black central point.[3]

Uses.—Petroleum has been successfully used in the treatment of *scabies*. After having been long employed as a popular remedy for this affection it was adopted by physicians, some of whom pronounced it quite as efficient as sulphur and much more eligible on account of its not ruining the body and bed clothing of the patients. Decaisne alleged it to be an insecticide of certain efficacy, not only of the acurus scabiei, but also of body and head lice. In Berlin its powers were tested by Asché, who stated that the treatment of the itch by its means was on an average of four days' duration, and that it occasioned no irritation of the skin.[4] A military surgeon in France, M. Morrisson, claims that two applications of the oil suffice for a cure, which he performed in ten cases, using gentle

[1] Richter, Aus. f. Arz., iii. 287.

[2] Clemens, Prager Vierteljahrs., lxxxix., Anal. 8; Mayer, Br. and For. Med.-Chir. Rev., Ap. 1866, p. 542; Bull. de Thér., lxxiii. 45; Humbert, ibid., lxxvi. 378; Lugeol, ibid., lxxix., 235.

[3] Ogston, Edinb. Med. Journ., xvii. 544.

[4] Prager Vierteljahrs., lxxxviii., Anal. 70.

friction with a flannel cloth saturated with petroleum.[1] M. Bouchut has published testimony quite as positive, and apparently conclusive. These statements would appear sufficient to demonstrate the efficacy of the treatment, and yet when it was employed at the hospital for skin diseases in Paris (St. Louis), by Lailler, Hardy, and Hillairet, these gentlemen assert not only that it failed in a majority of the cases, but that its application in some cases was painful and produced sleeplessness, intoxication, and an eczematous eruption of the skin.[2] On the whole, petroleum must be regarded as at least one of the most certain cures for itch, and not a more objectionable one than sulphur, which is also liable to irritate the skin if efficiently, that is to say, vigorously used. It is said to be equally successful in the treatment of *prurigo*, although its primary action is to induce smarting and redness.[3] These effects may be mitigated by associating it with almond or olive oil, or with glycerin.

Dr. Fayrer, of Bengal, made use of petroleum in the treatment of *wounds*, and regarded it as possessing "some, if not all, of the advantages assigned to carbolic acid for this purpose." He used it undiluted, or diluted with equal parts of oil or glycerin, and considered that it possessed some deodorizing power, and appeared to limit suppuration, restrain the development of septic miasmata in the discharges, and retard their decomposition.[4]

The uses to which this oil was applied by the ancients, as described above, have been imitated in modern times, particularly its internal administration in *atony of the bladder*, and its application by friction to the perineum for the same purpose. It has been reputed an efficacious remedy for *worms*, especially *tapeworms*, and is certainly a useful embrocation in *muscular rheumatism*, and in chronic *stiffness of the joints*. It also forms an efficacious liniment for *chilblains*. Thus its uses are, many of them, the same as those of oil of turpentine.

Administration.—Coal oil may be given internally in doses of from five to ten drops in the same way as the oil of turpentine. For the cure of tapeworm larger doses, such as half a fluidrachm, may be used. When employed in liniments, its odor may be partially covered by that of some agreeable essential oil.

MEZEREUM.—Mezereon.

Description.—This is the bark of *Daphne Mezereum* and *D. Gnidium*. The former is a native shrub of Europe, where it grows from north to south, in light calcareous soils, as an underwood in forests and thickets. It bears clusters of very fragrant flowers, of a white or pale-rose color, and a bright red, shining, and fleshy berry. D. Gnidium belongs to the south of Europe, and has a very

[1] Bull. de Thér., lxxxi. 41.
[2] Bull. et Mem. de la Soc. Méd. des Hôp. 1865, p. 116.
[3] Bull. de Thér., lxix. 34.
[4] Edinb. Med. Journ., xv. 493.

different aspect. Its berry is at first green, but afterwards becomes black. Mezereon bark, "as it comes to us, is usually in strips from two to four feet long and an inch or less in breadth, sometimes flat, sometimes partially rolled, and always folded in bundles or wrapped in the shape of balls. It is covered externally with a grayish or reddish-brown wrinkled epidermis, very thin, and easily separable from the bark. Beneath the epidermis is a soft greenish tissue. The inner bark is tough, pliable, fibrous, striated, and of a whitish color. When fresh it has a nauseous smell, but in the dry state is nearly inodorous. Its taste is at first sweetish, but afterwards highly acrid, and even corrosive. It yields its virtues to water by decoction."[1] The active principle of the plant is supposed to reside in *mezerin*, an acrid resin, which, by its union with fatty substances, forms mezereon ointment.

History.—Daphne Mezereum, according to Strumpf, appears to have been less used by the ancients as a medicine than D. Gnidium, although Diokles employed the berries of the former to prepare a gargle for putrid sore-throat. Tragus gave the first good account which we possess of the former variety, and he states that its flowers are useful in dropsy. Subsequently the leaves, and the bark of the trunk, branches, and roots, were held to be cholagogue, and useful in expelling morbid secretions generally. They were much used as a secret emmenagogue. Many writers, and among them Ambrose Paré, held mezereon to be one of the best remedies for the plague, as well as for the effects of animal poisons, when it was employed in such a manner as to produce copious evacuations from the alimentary canal and from the skin. In Siberia women and effeminate men are said to employ the berries for the purpose of bringing color into their cheeks. Russian peasants take as many as thirty of them at a dose for a purge, and give them to children as an emetic in whooping-cough. The Finlanders use them also for intermittent fever.(?) According to Villars, in Dauphiny the peasants will take eight or ten of the berries as a purgative dose. Leroy, in 1767, was the first to call the attention of physicians to the value of the bark as an epispastic, a fact which he had learned from the peasants of the District of Aunis.[2] A certain Schlegel used a secret remedy for chronic ophthalmia, which consisted in pieces of mezereon bark worn in holes punctured in the lobe of the ear. In Russia, according to Pallas, it is employed as a remedy for toothache.[3]

Daphne Gnidium is thought to be the species particularly described by Dioscorides under the name of Chamelæa. He represents it as a drastic and hydragogue cathartic, and as very irritating to the fauces, and says that with nitre and vinegar it excites sweating. Matthiolus makes very similar statements, and confirms them by examples of dangerous vomiting and purging caused by this plant. Neither

[1] U. S. Dispensatory.
[2] Jourdan, Dict. en 60 vol., Art Garou.
[3] Mérat and De Lens, op. cit., ii. 584.

of these authors alludes especially to the bark as being used in medicine.[1]

Action. *On Animals.*—According to Linnæus, six berries destroyed a wolf. Lange saw a scruple of the same, in powder, kill a dog, and the mucous membrane of the animal's stomach was swollen and studded with bloody points. In horned cattle it produced bloody purging. But six berries given to a rabbit produced no effect. Gmelin states that bees avoid the flowers of this plant. Birds, on the other hand, are said to eat the berries without harm, and without their flesh becoming poisonous.[2] The experiments on dogs by Orfila do not appear to have given rise to the ordinary phenomena of poisoning by mezereum. The animals neither vomited nor were purged, but perished by gradually drooping and pining. The intestinal mucous membrane was inflamed in the manner already described.

On Man.—Eating a few berries is sufficient to excite very severe pain in the stomach, vomiting, and violent diarrhœa. Brandt and Ratzeburg report that a child vomited inordinately after eating two of them. Lange states that the peasants of Brunswick employ it as a purgative, eight grains of the powdered seeds being sufficient to produce twenty evacuations, and also that the women often produce abortion by its use. A child, four years of age, who had eaten some mezereon berries, experienced a sense of burning in the mouth, and general distress, and, after some milk had been taken, vomiting ensued, and great thirst. The fauces were very much injected. In the course of an hour complete narcotism succeeded, the eyeballs were turned upwards, the pupils were contracted and insensible, and the muscles of the limbs twitched; but there was neither diarrhœa nor diuresis. The symptoms soon disappeared under treatment. A more serious case is the following: A hardy peasant, who was much troubled with hæmorrhoids, took forty berries as a laxative. He was soon attacked with very severe colic, continual vomiting, and almost incessant purging with bloody and slimy stools. Complete prostration ensued, with giddiness and disturbance of the head. On the following day his face was pale, cold, and collapsed, and the pupils dilated; he recognized no one, and suffered unquenchable thirst, with burning heat in the mouth, fauces, œsophagus, and stomach. The epigastrium, and indeed, the whole abdomen, were painfully sensitive to the slightest touch. The voice was unnatural, weak, and tremulous; the breathing anxious, laborious, and short; the pulse very frequent, unequal, hard, and concentrated; the urine acrid, and blood-red; the limbs cold, and the whole body covered with a cold sweat. The patient recovered after a cautious antiphlogistic treatment of four weeks' duration.[3] Death has sometimes been the consequence of an excessive dose of the medicine, and been preceded by convulsions, syncope, and copious mucous discharges from the bowels, vagina, and bladder. After

[1] Comment. sur Dioscoride, iii. ch. 167; vi. ch. 33.
[2] Wibmer, Die Wirkung der Arzneim. u. Gifte, ii. 285; Mérat, art. cit.
[3] Strumpf, op. cit., ii. 498.

death inflammation of the gastro-intestinal mucous membrane has been detected.

The bark, when chewed, is not at first pungent to the taste, but in a little while excites a burning heat in the mouth, which lasts for many hours. In medicinal doses the decoction stimulates the salivary glands to copious secretion, and promotes discharges from the mucous membranes and the skin. Diarrhœa is apt to occur if the bowels are easily moved. The saliva and the other secretions are said to acquire a peculiar odor. Larger medicinal doses resemble in their effects those above described as poisonous.

The skin is very susceptible to the action of mezereon. When fresh or when softened by soaking in water, the bark acts as a rubefacient, and at length occasions vesicles, which sooner or later discharge copiously a watery fluid, and leave behind moist, painful, and offensive sores, which not unfrequently are surrounded with pustules, and are extremely difficult to heal. The juice of the leaves, when rubbed upon the cheek of a girl of fair complexion, produced a burning pain, and swelling of the whole face, especially of the nose, eyelids, and forehead, which soon assumed the aspect of erysipelas with vesicles. To these symptoms were added a constant, violent, and painful sneezing and obstruction of the nostrils. Delirium followed, with a dull, insufferable, tensive pain in the temples, tormenting dryness of the fauces, cough, fever, and scalding and high-colored urine. Antiphlogistic means subdued the inflammation, and the cuticle of the affected part exfoliated. The patient, however, remained feeble, spiritless, and almost imbecile. She was soon attacked with a typhoid fever, which, after a protracted course, merged into "hectic" and terminated fatally nine months after the original symptoms.

Uses.—As an internal medicine, mezereon is employed chiefly in compound decoctions for diseases of the skin, and especially in the secondary forms of *syphilis* affecting this tissue, the periosteum, or the bones. According to some writers its efficacy is less decided in purely syphilitic affections than in those which have been regarded as a consequence of a mercurial course of treatment. In 1769 Russell published[1] a number of cases intended to illustrate the power of the medicine in secondary syphilis, and they do indeed show that it is probably not without some influence on the nocturnal pains and periosteal swelling which belong to this affection. But it does not seem to have been really and radically curative in a single instance. Its use was almost always followed by that of corrosive sublimate. From its effects in some old syphilitic complaints, Eberle was inclined to attribute to it considerable remedial virtues. Home, in 1783, certified not only the virtues of mezereon in curing syphilitic periosteal swellings, but also a variety of tumors, some of which he calls scirrhous. He found it inefficacious in scrofulous enlargements of the glands.[2]

In *cutaneous affections* of long standing, and not of syphilitic ori-

[1] Med. Obs. and Inq., iii. 189. [2] Clinical Exper., 3d ed., p. 466.

gin, but depending rather upon a torpid state of the system, the preparations of mezereon have enjoyed some reputation, but upon insufficient grounds, because the medicine was always used in combination with others more powerful than itself. Cullen, Pearson, Parry, and others speak favorably, but not very emphatically, of its usefulness in this class of diseases. A review of their cases renders it probable that its efficacy was almost entirely limited to instances in which a *rheumatic* element predominated. In these, and in chronic gouty affections of the joints, attended with periosteal thickening and stiffness, Vogt regards the medicine as having been useful.[1]

Loebenstein Loebel insists upon its advantages in *asthenic croup*, as a substitute for seneka, on account of its greater promptness and certainty of action. But Sachse very properly objects to giving so violent an emetic to young persons.[2]

The medicinal action of mezereon is more clearly manifested by its external operation as a *counter-irritant*. Its power of exciting a strong, steady, and permanent irritation of the skin is constantly made use of for the purpose of supplying the place of cantharides, or of keeping up the less permanent action of the latter. In protracted diseases, therefore, or in those the nature of which is to run a tedious course, the derivative action of mezereon is most frequently invoked. It is also employed as a stimulant to improve the action of foul or ill-conditioned ulcers. Peas impregnated with the alcoholic extract of mezereon are used for the purpose of maintaining the discharge from issues.

Administration.—A decoction may be employed in prescribing this medicine for *internal use*. The dose is from four to eight fluid-ounces three or four times a day. It is, however, seldom used, the compound decoction of sarsaparilla into which mezereon enters forming a preferable preparation.

Externally, and to vesicate the skin, the recent or even the dried bark may be used. The former stripped of its epidermis is applied by its outer surface upon the skin, which should first be bathed with vinegar. A compress and bandage are required to bring it into close apposition with the body. From twenty-four to forty-eight hours are necessary for its full effect, and fresh pieces of the bark should be applied every morning and evening. If it be intended to maintain the first impression, they should be renewed every day, care being taken, however, not to allow the inflammation to extend too deeply. The dry bark, if not too old, will produce similar effects, but must first be soaked in water to render it pliable. Once the discharge has been set up, it may be sustained by mezereon ointment. In general, however, and in this country almost exclusively, mezereon ointment (although no longer officinal) is employed, and only for the purpose of maintaining a discharge from surfaces made sore by cantharides, caustics, and other irritants. Unless some good reason to the contrary exist, canthari-

[1] Pharmakodynamik, ii. 324. [2] Ibid., 325

des is always used to establish the suppuration when a considerable surface is to be affected, and as soon as the purulent discharge slackens it may be renewed and maintained by mezereon ointment.

Treatment of Poisoning by Mezereon.—The stomach should first be evacuated by means of copious albuminous or mucilaginous drinks given lukewarm. Milk and fatty oils may also be administered; vegetable acids, and albuminous clysters, if purging occurs; emollient and cool poultices to the abdomen; sinapisms to the extremities; and if there are signs of local congestion, depletion may be cautiously resorted to.

PYRETHRUM.—Pellitory.

The root of the Anacyclus Pyrethrum (Linn.) is a native plant of Barbary and Asia Minor. It is found in commerce in cylindrical pieces about the length and thickness of the little finger, wrinkled longitudinally, of an ash-brown color externally, and breaking with a resinous fracture which is white and has a radiated appearance. It is inodorous, and when chewed has an acrid taste, and excites a burning and prickling sensation in the mouth and fauces, with a copious discharge of saliva. Its taste was compared by Linnæus to that of senega. Its acrimony depends upon a peculiar principle, *pyrethrin.*

Pellitory is a powerful local irritant, and acts upon the skin as a rubefacient.

Owing to its sialagogue properties, it has been much used to relieve local pains about the face and head. Boiled in vinegar and applied to the cavity of carious teeth, it is said to relieve *toothache.* In *paralysis* of the tongue and pharynx, and in relaxation of the uvula, it may be used as a masticatory or in a gargle. Its powder may be employed as a sternutatory in chronic inflammations of the frontal sinuses.

Administration.—Its *dose* as a *masticatory* is from thirty to sixty grains.

SABINA.—Savine.

Description.—"The tops of the Juniperus Sabina," a native evergreen shrub of Southern Europe. It is reported also to grow wild in the neighborhood of our northwestern lakes. The name of the plant is said to be derived from the Sabine territory, where it abounds.[1] The leaves as well as the tops are used in medicine. They have a peculiar, strong, heavy, and unpleasant odor, and their taste is bitter, acrid, and disagreeable. These qualities depend upon the presence of a large quantity of an essential oil, which is obtained by distillation. The leaves impart their virtues to alcohol and to water.

[1] Mérat and De Lens, Dict., iii. 695.

Medical History.—Of ancient writers, Dioscorides was the first to describe the qualities of savine.[1] The leaves, he says, are capable of arresting the progress of phagedenic ulcers; they form with honey an excellent cosmetic, and promote the cure of carbuncles. An infusion of them in wine causes bloody urine, and applied as a fomentation to the belly of pregnant women they produce abortion. The account given by Galen is very much to the same purpose. He dwells particularly on its use in gangrenous sores of an indolent character, and states that on account of its volatile constituents it excites the menses more powerfully than any other agent, provokes bloody urine, destroys the life of the fœtus, and causes its expulsion.[2] Very similar virtues are ascribed to savine by Rhazes and other Arabian writers, one of whom warns against the use of the medicine by females of an ardent temperament. Another recommends a preparation of it in vinegar as a remedy for alopecia.[3] Other ancient authors speak of the use of savine ointment in chronic gout and rheumatism. But it was most celebrated for its emmenagogue properties, which were habitually evoked for the criminal purpose of destroying the product of conception in order to conceal incontinence, or to escape the incumbrance of a family. In later times this property has been denied to savine by various authors of weight and reputation, but the proofs of its reality are unequivocal and conclusive.

Action. *On Animals.*—Orfila's experiments in which the powder of savine was introduced into the stomach of dogs, prove it to be a powerful irritant, causing severe pain, inflammation of the gastro-intestinal mucous membrane, and death. When applied to a wound made in a dog's thigh, it produced violent inflammation of the limb, with serous infiltration, followed by the animal's death.[4] Mr. Letheby[5] gave two drachms of powdered savine mixed with food to a small terrier dog. In two hours and a half it began to vomit, and continued to do so at intervals for an hour and a half. It then lay down exhausted, and in two hours afterwards was found in the same position, insensible, and comatose, with a slow laboring pulse. In this condition it remained for eight hours, passing a good deal of blood by stool. At the expiration of fourteen hours from the commencement of the experiment, the animal died. The brain was found gorged with blood; the lower bowels were highly congested, and contained blood.

The German horse-dealers are said to administer this substance to their animals for the purpose of making them lively and spirited. According to Hillefeld, a drachm of oil of savine, given to a male cat, produced a discharge of bloody urine, and after the animal's death the bladder contained blood, and its lining membrane was ecchymosed.[6] Mitscherlich's experiments prove that *oil of savine* is a powerful poison. It is absorbed into the system, for its odor can

[1] Liv. i. ch. 88.
[2] Ebn Baithar, i. 6, 7.
[3] Ibid.
[4] Toxicologie, 5ème ed., ii. 130.
[5] Lancet, June 7th, 1845.
[6] Mitscherlich, ii. 659.

be detected in the cavities of the body and in the blood, as well as in the breath and urine. The intestinal lesions it produces are not in themselves mortal, for they seldom extend beyond vascular congestion, and an abundant exfoliation of epithelium. The kidneys are greatly congested, and muscular irritability continues for a long time after death. The symptoms, as observed by Mitscherlich, were as follows: the movements of the heart and thorax were hurried; in one experiment the urine was several times voided, dulness and insensibility supervened, the extremities were paralyzed, the respiration labored, the pulse could not be counted, and death took place after a very protracted struggle.

On Man.—When savine or its volatile oil is applied upon the skin or upon the surface of wounds, it produces inflammation, but more slowly than mustard or its essential oil. When the back of the hand is kept moistened with a few drops of the oil of savine, a moderate degree of prickling is felt after the lapse of ten or twelve minutes; but at the end of an hour, even, the sensation is not strong, and there is scarcely any redness.

Internally small doses of the leaves or of the oil do not give rise to any striking phenomena; at most they slightly augment the discharge of urine. Moderately large doses are apt to produce some disturbance of the stomach; but if they are repeated, arterial excitement ensues, the quantity of urine and the desire of voiding it are both increased, and the menstrual flow is apt to be brought on, or, if present, to be augmented. Still larger doses produce general distress, pain in the stomach, vomiting, diarrhœa, strong excitement of the circulation, and local sanguineous congestions. Sometimes the urine is bloody. In cases of still greater, or of mortal violence, the stools also are bloody, and symptoms of intestinal inflammation are developed. In pregnant females, abortion is apt to occur. After death, inflammation of the intestines is discovered, and sometimes congestion of the brain.

Dr. Van de Warker,[1] in experiments on himself, found that ten minims of oil of savine occasioned heat and flushing of the face, circumscribed pain in the temples, gastric heat, flatulence, a sense of intoxication, followed by severe headache and inability to sleep. On taking two doses of fifteen minims each, at three hours interval, the same symptoms occurred more intensely; the odor of the drug exhaled from the breath, skin, and urine, which secretion was slightly increased, there was nausea, followed by borborygmi, pain in the track of the colon, and burning at the anus. There was no strangury. The sphygmographic tracings showed that the primary action of the drug is powerfully stimulant, and that it is followed by debility and languor.

A case is reported by Mohrenheim of a pregnant female who took an infusion of savine to produce abortion.[2] It caused incessant vomiting, and some days afterwards excruciating pains, abortion, flooding, and death. Rupture of the gall-bladder was found on ex-

[1] The Detection of Criminal Abortion, 1872. [2] MURRAY, Apparat. Med., i. 59.

amination of the body, and bile in the abdominal cavity with peritonitis. Many other illustrations might be adduced of the extreme danger to life of large doses of this medicine. In most of the cases, signs of a violent inflammation of the intestinal mucous membrane and of the peritoneum were detected after death. Notwithstanding the almost certainly fatal consequences of producing abortion by means of savine, there is reason to believe that it is much more frequently employed than is commonly imagined for criminal purposes, but fortunately in such doses as fail of their purpose and only produce, instead, severe vomiting and purging.

Kopp relates the case of an infant who died from inhaling the fumes of a bottle of oil of savine which had been left open near its cradle all night, after having been used to bathe the child's hip.[1]

Uses. *Uterine Derangements.*—Savine is particularly called for in cases for which uterine stimulants are appropriate, but as it is perhaps the most powerful agent of the class it must be very circumspectly used. Nearly all writers of enlarged experience concur in attributing to the medicine very decided emmenagogue powers. According to Cullen, it showed a more powerful determination to the uterus than any other agent he employed.[2] Home published cases illustrating its efficacy which he regarded as greater in the "debile" than plethoric habits.[3] The cases of *amenorrhœa* to which it seems most appropriate are thus described by Vogt.[4] They occur in persons of a torpid and relaxed constitution, and disposed to mucous accumulations and blennorrhœal discharges; in other words, there is a general atony of the system in which the uterus participates, and of which the capital sign is leucorrhœa occurring exclusively or in an aggravated degree about the catamenial period. Under these, or very similar circumstances, Pereira declares that savine "is the most certain and powerful emmenagogue of the whole materia medica." He gave the oil a preference over all other preparations in treating amenorrhœa, and in doses of from two to six drops diffused in a mucilaginous or oleaginous mixture. Kopp recommended savine as a very effectual remedy for *dysmenorrhœa*, particularly in unmarried females,[5] and when it was attended with expulsive pains and the discharge of scanty, dark, and clotted blood, or when, as in other cases, there was an augmented flow taking place irregularly, ceasing, then reappearing, etc. He usually prescribed it in conjunction with borax, and, when there was a great want of tone in the system, added bark, iron and other tonic medicines. The same writer extols the efficacy of savine in *sterility* depending upon a torpid state of the sexual organs of the female. He states also that it acts as an excitant of the venereal propensity, and relieves *menorrhagia* when it depends upon a chronic passive congestion continuing after delivery.[6] Wedekind, Gunther, and Sauter having also furnished numerous proofs of its anti-hemor-

[1] Richter, Ausfürlich. Arzneim., suppl. Bd. 408.
[2] Mat. Med., ii. 366.
[3] Clinical Exper., p. 419.
[4] Pharmakodynamik, ii. 182.
[5] Ibid.
[6] Richter, loc. cit.

rhagic virtues in cases of undue menstruation, and of threatened abortion depending upon a presumed inertia of the uterus.[1] The dose employed for this purpose was from five to fifteen grains of the powder given three times a day, and that for several months together.

M. Aran has published several cases which serve to strengthen the grounds of the doctrine.[2] He says that, strange as it may appear, this powerful emmenagogue has the property of suspending *uterine hemorrhages*. The experience of Beau is to the same effect. He generally succeeded in arresting the loss by the administration of one grain, daily, of powdered savine in pilular form, but in some cases a second dose during the day was necessary.[3] Some writers have spoken of the efficacy of savine in *chlorosis*, but this effect is doubtless secondary and indirect, depending upon its power of regulating the menstrual discharge, by the suppression of which a chlorotic state is very commonly prolonged, if not occasioned.

Savine has been also used successfully for the relief of *atonic gout* and *rheumatism* of long standing, and occurring in persons of a cold and phlegmatic temperament. Friction of the affected joints with oil of savine, or with an infusion of the tops of the plant, or with savine ointment may be employed. It probably has no superiority over any other rubefacient application, when applied externally, but it is also, according to Hufeland, one of the most effectual of all internal remedies for *chronic gout*. He directed from twelve to twenty-four grains in the twenty-four hours, or a decoction made from twice that quantity.

Savine is also an excellent *vermifuge*, but not more so than other less irritating agents. Ray recommended a decoction of the leaves, or their expressed juice to be given with milk. Other writers have prescribed the same preparations as enemata to destroy ascarides of the rectum.

Savine is *contraindicated* during pregnancy, and whenever the circulation is readily excited it cannot be administered without risk. Every tendency of blood to the head, or lungs, or any local congestion or inflammation whatever, should form a sufficient ground for withholding it.

External Application.—Savine is used to excite, or more generally to prolong, a discharge from the skin after vesication by cantharides. It is also employed to destroy *venereal warts* and other excrescences by causing ulceration of the skin around them. It was recommended for this purpose, by Ferrus, and subsequently by numerous other writers upon the venereal disease, who direct it to be applied in powder to the warts after they have been moistened. Others have prescribed it mixed with mercurial ointment. Vidal recommends equal parts of savine and burnt alum,[4] and Christison, like proportions of savine and verdigris. The use of savine as an escharotic in cases of nasal *polypus* is said to be popular in Hungary.

[1] Dieu, Mat. Med., iii. 260.
[2] Bull. de Thérap., xxx. 61.
[3] Bull. de Thér., xliii. 140.
[4] Ibid., xxviii. 477.

Dr. Moller relates a case which was ineffectually treated by surgical methods, for the tumor was always reproduced, until applications were made to it of a decoction of savine, under which it withered and finally disappeared. The same writer mentions the successful use of strong savine ointment for the removal of *condylomata*, and of a certain cutaneous tumor (*fibroma papillare?*) which had recurred after excision, but was finally extirpated by savine ointment.[1] Its preparations continue to be used, as in ancient times, for hastening the discharge of the *gangrenous* portions of ulcers, etc., and generally for promoting suppuration whenever this process requires quickening. In gangrenous sores it has been recommended mixed with camphor. Savine cerate is habitually employed to prolong the discharge from blisters, issues, etc.

Administration.—Freshly-gathered savine is by much more effectual than the dried plant. It may be administered in *substance* in the form of powder, and in doses of five or six grains repeated three or four times a day, and gradually increased to twenty. Owing to the difficulty of pulverizing it, Eberle suggests, as a convenient form of administering savine, to beat it up with honey, or any proper syrup, to the consistence of a conserve. An *infusion* may be prepared by digesting sixty grains of the fresh herb in half a pint of boiling water. The *fluid extract* of savine is officinal. Its *dose* is from five to fifteen minims. The *oil*, which is officinal, may be given in doses of from two to ten drops. The *cerate* is officinal. It is made by incorporating three fluidounces of fluid extract of savine with twelve troyounces of resin cerate.

Oleum Tiglii. See *Cathartics*.

MONARDA.—Horsemint.

Description.—Horsemint is an indigenous plant found abundantly in the Middle and Southern States of the Union. The whole herb is employed. It has an aromatic smell, and a warm, pungent, bitterish taste. It is used in hot infusion as a domestic remedy for flatulent colic and nausea, and by the country folk as an emmenagogue, and also to cure intermittent fever. It is more valuable on account of the essential oil (Oleum Monardæ) with which it abounds, and which is an active counter-irritant. Atlee, by whom attention was first directed to its qualities,[2] states that the smallest drop immediately diffuses a pungent, aromatic heat over the tongue and fauces, which remains a considerable time, and that when applied to the back of the hand, it excites redness, heat, pain, and vesication. He used it diluted with alcohol as an embrocation in *chronic rheumatism*, and in a pure state to produce vesication of the back of the neck in a patient affected with mania-a-potu. In a case of partial deafness it was rubbed upon the scalp, and perfectly

[1] Virchow's Arch., xviii. 171. [2] Am. Med. Recorder, ii. 496.

restored the hearing; in *neuralgia*, a liniment, in which it was associated with tincture of camphor and laudanum, afforded speedy relief, and the same was also used with advantage in hemiplegia and other *paralytic affections*. Its stimulant effects were shown during an epidemic of *typhus*, in which it counteracted the tendency of the extremities to grow cold, and also in *cholera infantum* when its application by friction to the abdomen restrained the tendency to collapse, and very generally relieved irritability. The latter statement is confirmed by Eberle.

Administration.—Oil of horsemint should generally be used in a diluted state, even as a rubefacient. Internally it may be given in the dose of two or three drops mixed with sugar and water.

ANIMAL IRRITANTS.

CANTHARIS.—Cantharides.

Description.—*Cantharis vesicatoria* is a native insect of the southern parts of Europe, but is now found in all the countries of that quarter of the globe. For commercial purposes, it was at first chiefly derived from Spain, and hence acquired its popular name. A Russian variety is said to be the most powerful of all. This insect is found upon trees and shrubs, and especially upon the ash, lilac, and privet; it is also, but more rarely, obtained from the rose, the plum-tree, etc.

The officinal species is from half an inch to an inch in length, by about two lines in breadth. It is distinguished by its beautiful wing-cases, which are iridescent, but the predominant colors are a brilliant and beautiful golden green. When alive, cantharides exhale a strong, fetid, and penetrating odor, by which they readily betray their presence. It is so offensive, that public walks frequented by them are deserted until their season has passed away. Their taste is acrid, terebinthinate, and even caustic. To this day, the mode of catching and preserving them for use is nearly the same as that described by Dioscorides, and which is mentioned below.

Several species of *Mylabris* and *Meloë* exist, whose properties resemble those of the officinal cantharis. The latter was unknown to the ancients, who probably employed species of Mylabris, some of which are to this day used for blistering in the East. This is evident from the fact that the insects mentioned by Dioscorides are described as having their wings marked by transverse yellow bands, a distinctive mark of a species of Mylabris, and which does not belong to cantharides. It has been thought that the ancients gave the name cantharides to several species of insects, and to terminate this confusion Linnæus proposed to drop the name altogether and adopt that of meloë vesicatorius to distinguish the insect from

non-vesicating cantharides. Several American species exist, which possess powers quite equal to those of the Spanish fly. One of these was described by Dr. Isaac Chapman, in 1805. It is a native of Pennsylvania, and is known as the *C. vittata*, or potato fly. *C. cinerea*, *C. marginata*, *C. atrata*, *C. Nuttali*, and *C. albida*, are all native species, and are strongly endowed with vesicating properties. The last two, especially, might well be substituted for the officinal insects.

The researches of Robiquet, in 1810, and of others, demonstrated the sources of the active properties in cantharides. They are, first, a highly poisonous and very volatile oil, of a greenish color, but which possesses no vesicating properties, and second, a substance to which Thompson gave the name of *cantharidin*. Upon the latter, the power of the insect as a vesicant depends. It resides almost exclusively in the soft tissues, and is regarded as a concrete oil. Its color is white, and it forms shining, crystalline, and micaceous scales, which are vaporizable by a strong heat. In its pure or isolated state, cantharidin is insoluble in cold water or alcohol, but in its natural state either of these liquids may acquire its properties. It dissolves readily in ether and in oils. M. Dieu estimates its power as fifteen times greater than that of cantharides. Cantharidin has also been obtained from C. vittata, Mylabris cichorii, and from different species of Meloë.

The following preparations are officinal:—

Charta Cantharidis.—*Cantharides Paper.*

It is prepared by coating paper with a liquid made by boiling together white wax, spermaceti, olive oil, Canada turpentine, cantharides, and water.

Ceratum Cantharidis. *Cantharides Cerate.—Blistering Cerate.*

This cerate consists of cantharides, yellow wax, resin, and lard.

Ceratum Extracti Cantharidis.—*Cerate of Extract of Cantharides.*

It is prepared by mixing a soft alcoholic extract of cantharides with resin, wax, and lard.

Collodium cum Cantharide.—*Collodion with Cantharides. Cantharidal Collodion.*

This preparation is made by dissolving pyroxylon, or gun-cotton, Canada turpentine, and castor oil in a mixture of alcohol and ether which has been used to obtain the active properties of cantharides by percolation. It should be kept in well-stoppered bottles.

Linimentum Cantharidis.—*Liniment of Cantharides.*

This liniment is a solution of the active principles of cantharides in oil of turpentine.

Tinctura Cantharidis.—*Tincture of Cantharides.*

This tincture contains the virtues of a troyounce of cantharides in two pints of diluted alcohol.

Unguentum Cantharidis.—*Ointment of Cantharides.*

It is made by mixing together one part of cantharides cerate and

three parts of resin cerate. It is not intended to vesicate, but only as a dressing for blisters.

Medical History.—Hippocrates[1] mentions first among the medicines which promote the menstrual discharge, "five cantharides from which the wings and legs have been removed." It is said that these parts were rejected, not, as had been believed, because they were inert, but on account of their extreme acridity. According to Nardo, the vesicating principle resides chiefly in the wing-cases. As already stated, however, it is now certain that the original opinion is the correct one, and that the parts referred to are really inert. In regard to *C. vittata*, the truth appears to be that the blood, the peculiar fatty substances of certain accessory glands of its generative apparatus, and the egg of the insect contain its peculiar vesicating principle.[2] Ferrer, by treating separately with chloroform the different parts of officinal cantharides, found that the soft tissues furnished somewhat the largest proportion of cantharidin. But he concluded that in vesicating insects the irritant principle resides equally in all the organs.[3] The more precise experiments of Dr. Leidy, agreeing as they do with the ancient statement, appear to have a greater probability in their favor. Hippocrates speaks of the use of cantharides in dropsy, amenorrhœa, leucophlegmatia, and jaundice, and of their external action in hydrometra. Dioscorides describes the manner of killing the insects (cantharides, buprestes) for preservation. They are either placed, he says, in an earthen vessel, the mouth of which, after being covered with a thin cloth, is inverted over another vessel containing boiling vinegar, or else held in a sieve over a pan of hot coals.[4] They are, he states, of a corrosive nature, causing inflammation and ulceration, and hence are used along with medicines that cure diseases of the skin, and cancer. They act as an emmenagogue when applied upon a pessary. Some, it is further remarked, attribute to them anti-hydropic virtues, because they are diuretic. Pliny and others state that the wings and head, when taken in liquids, are able to counteract the poisonous effects of the bodies of these insects. The naturalist just mentioned alludes to their causing violent pains in the bladder, and relates that a certain Roman knight was killed by taking them for a lichenous eruption. He adds, however, that they are unquestionably useful when employed externally.[5] The poisonous effects of cantharides are thus described by Dioscorides.[6] The patient feels a gnawing pain in every part from the mouth to the bladder. He perceives a terebinthinate taste in the mouth, and heat in the right side of the præcordium. The dysury and hæmaturia are great. The stools resemble scrapings of the intestine, as in dysentery. There is always nausea, with fainting, spasms, and at last delirium. For this condition the author recommends oily and mucilaginous drinks, and enemata. Arabian physicians afterwards prescribed the injection of oil into

[1] Edit. Van der Linden, ii. 375.
[2] Leidy, Am. Journ. of Med. Sci., Jan. 1860, p. 60.
[3] Annuaire de Thérap., xx. 113.
[4] Op. cit., ii. 54, 55.
[5] Hist. Nat., xxix. 30.
[6] Op. cit., vi. 1.

the bladder. Aretæus[1] speaks of blistering the scalp in epilepsy; he calls attention to the strangury which cantharides are apt to excite, and recommends milk to be given for several days before the blister is applied. In another place[2] this author states that cantharides may produce inflammation of the bladder, and bloody urine. Galen follows preceding authors in his history of this insect, but declares, in opposition to them, that all parts of it are alike endowed with medicinal qualities. This statement, as was seen above, is not literally correct. Celsus[3] says: "If any person have drunk cantharides, he ought to take panaces bruised with milk, or galbanum with the addition of wine, or milk by itself." Matthiolus, in commenting on the above description of Dioscorides, refers to a statement made by later authors, that sometimes the genital organs become violently inflamed in the use of this agent. But neither he nor any ancient writer alludes to sexual excitement as an effect of large doses of cantharides; a fact which may perhaps be explained by the comparatively feeble action of the insects they employed (mylabris). The later Greek and Arabian schools continued to employ cantharides in the same cases as those in which the writers already cited had recommended them, or at least in very similar ones, and both internally and externally. The former use of the medicine seems, however, to have grown obsolete, and, indeed, to have fallen into such discredit that, in 1698, the London College of Physicians caused one of its Fellows to be imprisoned for having prescribed it internally.[4] This person, named Groenvelt (Angl. Greenfield), was a native of Holland, and a distinguished lithotomist. He composed a work in which cantharides are exalted as a remedy for various affections of the urinary passages, and for vesical catarrh in particular. He also vaunts the power of camphor, when associated with it, to correct its acrimonious qualities and prevent strangury, both when given internally and when mixed with blistering ointment. It may be remarked that he was in the habit of giving much larger doses of camphor for this purpose than it is now usual to prescribe, as much, even, as from ten to twenty grains at a dose.[5]

The use of cantharides for vesication was rendered general by the Arabians, who employed them particularly in soporose affections, for poisoned wounds, and to relieve deafness. After the revival of learning, Fernel was one of the first to apply the revulsive powers of fly-blisters to cerebral affections, and Houllier extended their use to obstinate affections of the skin, to neuralgia, and gout. During the greater part of the sixteenth century, these agents were used with suspicion and great reserve by Ettmüller and Sennert; but when the plague ravaged in Italy in 1575, Mer-

[1] De Morb. Diut., i. 4. [2] De Causis et Sig., x. [3] Book v. ch. 27.

[4] A certain Capivaccius, in the 15th century, maintained that cantharides might be successfully given in dropsy and suppression of urine.—Vid. CAMPET, Maladies Graves, etc., p. 175.

[5] A Treatise on the Safe Internal Use of Cantharides. Written in Latin by Dr. J. Greenfield, and translated by J. Marten. London, 1705.

curialis employed them with remarkable success. Although the method had been extensively adopted, it was nevertheless strenuously opposed by certain Galenists, and a dispute ensued, in which Saxonia advocated the use of blisters, and so thoroughly defended his thesis as to have it said of him that "writers since his time plainly follow him, and have hardly added anything upon the subject."[1] Among subsequent writers, Hoffmann has furnished the most complete account of the uses of vesication by cantharides.[2]

Action. *On Animals.*—The first experimenter with cantharides appears to have been Baglivi.[3] By injecting the tincture into the jugular vein of a dog, he produced great debility and suffering, with inordinate thirst, and death, preceded by signs of great pain and by convulsions. He found in the blood a number of little drops like oil. Hillefeld[4] gave to a dog a drachm of powdered cantharides mixed with water. An hour afterwards there were signs of great debility, but no anxiety, and at the end of four hours the animal moaned and howled continually, and passed urine and bloody fæces. He gradually grew weaker, and at last died in about twenty hours from the commencement of the experiment. No marks of inflammation were found in the bladder, except a few red points, but the intestinal canal was inflamed throughout, and in some places resembled a piece of scarlet cloth. Schubarth[5] produced almost exactly the same symptoms with a similar dose of the poison. The dog on which he experimented grew feeble and tremulous, and vomited, and his pulse became smaller and more frequent. The urine was scanty, and passed with difficulty, but was not high colored. The intestinal canal and the urinary passages were found greatly injected after death. Smaller doses were given to the other dogs, and produced a frequent desire to urinate, signs of salacity, and, in a bitch, an irritation of the sexual organs, shown by her rubbing them constantly upon the ground. The numerous original and collected experiments described in Orfila's treatise concur in showing almost identical results with those already cited, and need not, therefore, be detailed. In nearly all of them it may be remarked, however, that there was very little evidence of inflammation or of functional excitement about the genital organs. The absence of these symptoms, and especially of the former, which in the human subject occurs so frequently when poisonous doses of the substance are administered, adds another to the many motives already existing for a habit of caution in reasoning from the results of experiments in the lower animals to the action of medicines upon man. The experiments of Orfila and of Beaupoil led to conclusions of which the following is a summary.[6] In doses of from thirty to sixty grains powdered cantharides almost always are fatal to dogs of a medium size. The ingestion of the powder is generally followed

[1] Freind, on Fevers, p. 134.
[2] Op. Omn., vi. 67.
[3] Pract. Phys., p. 412.
[4] Wibmer, Wirkung, etc., iii. 253.
[5] Ibid., p. 262.
[6] Dict. de Méd. en xv. vol.

by vomiting, horripilations, some convulsive movements, and a restlessness indicative of severe pain. These symptoms are succeeded by coldness, depression, and death. On examination of the stomach and intestines, they are found uniformly, and the kidneys and bladder occasionally, to display signs of inflammation. When the powdered flies are applied to a wound, they excite great pain and inflammation, vomiting, depression, laborious breathing, etc., and ultimately destroy life. The experiments of Dieu[1] furnished results almost identical with those now described. In addition, he observed that if the powdered flies, mixed simply with water, were administered to dogs in doses of from thirty to fifty grains, a copious discharge of urine and fæces took place, and the action of the heart was strikingly reduced. When the medicine was exhibited along with distilled water of cherry laurel, the combined dose proved rapidly fatal, although each ingredient by itself was incapable of producing this result. Forty-five grains of camphor, mixed with thirty of cantharides, were fatal to dogs by producing a remarkable degree of depression and debility; but it was necessary to employ a drachm and a half of the former alone, and of the latter a much larger dose than the one stated, in order to produce a similar result. Alcohol, on the contrary, suspended, and finally overcame, the effects of the cantharides, just as the Italian experimenters found it to do in the human subject. The conclusion which these observers drew from their experiments, that the action of cantharides is essentially sedative, deserves attention. Not, however, that they prove this thesis; but they go far to demonstrate that the excitement which usually follows the application of blisters, and the internal use of cantharides, is due to the diffused and reflected influence of the local inflammation, and that the general depression which follows is owing both to a direct sedative action of the medicine and to a reaction from the local irritation of the internal organs as well as of the skin.

The action of *cantharidin* on animals has been tested by several experimenters. According to Orfila, fifteen grains introduced into the cellular tissue of a dog's leg destroyed the animal in three hours. The symptoms were like those produced by Spanish flies, but more severe. In Pulino's experiments, half a grain of cantharidin, dissolved in milk and administered to a dog, produced general loss of power, immobility, and death within half an hour. One and a half grains dissolved in fifteen drops of double-distilled laurel water destroyed a large rabbit almost instantaneously, although the same animal had, several days before, taken twenty drops of the laurel water without serious inconvenience. Two grains were inclosed in dough and administered to a small rabbit. The animal fell down insensible; the limbs were paralyzed, and the temperature of the body declined. Death occurred within three hours. According to Lissonde's experiments, one-sixth of a grain of cantharidin contains the vesicant virtues of one hundred and twenty

[1] Mat. Med., ii. 24.

grains of powdered cantharides. Its activity of course depends upon the degree of its solubility in its excipient; in this respect chloroform ranks first, and oily and fatty substances next. Applied to the skin it vesicates rapidly, and the exuded serum is albuminous and alkaline, and is itself capable of vesicating. Twenty-five milligrammes ($\frac{1}{7}$ gr.) killed a cat or a rabbit; twice that quantity, a large-sized dog. The effects were those so often pointed out in the course of this article; sedation so marked as to resemble that produced by dilute prussic acid; *e. g.* at first, and for a short time only, excitement, followed by great depression, fall of temperature, slowness of the heart's action, and finally convulsions and death in a state of profound exhaustion. That the poison is eliminated in part with the urine, is shown by this secretion imparting vesicant qualities to chloroform. Irritation of the urinary passages is not so apt to be determined by a single dose as by the repeated administration of small doses.[1]

The solubility of cantharidin in oils greatly facilitates the absorption of this substance, and hence their administration in poisoning by cantharides is to be avoided. When animals are poisoned with cantharidin dissolved in oil, the gastro-intestinal symptoms and lesions are said to be less, and the vesico-renal greater, than where cantharidin alone is used. These agree with the results of other experiments in proving cantharidin to be the irritating principle of Spanish flies, and especially that which occasions strangury.

On Man. Internally.—The action of cantharides when swallowed is that of an acrid irritant. Besides the disagreeable taste already alluded to, if the quantity taken be large, a burning heat is felt in the mouth, fauces, œsophagus, and abdomen; there is sometimes ptyalism, together with constriction of the throat, and a difficulty of swallowing so great that the attempt to drink excites violent spasms. Usually there is nausea and vomiting often of bloody matters; unnatural, fibrinous, and sometimes bloody stools, griping, meteorism, and extreme tenderness of the abdomen.[2] These symptoms of intestinal inflammation often terminate fatally. When death does not take place rapidly, other symptoms, which depend upon the absorption of the active principle, are displayed. There is an incessant desire to urinate, but a small quantity only of high-colored and scalding urine is voided with extreme suffering. The urine is sometimes bloody, and a burning pain is experienced in the region of the bladder and kidneys. The urine under these circumstances is highly albuminous. In some cases the genital organs are at the same time violently excited, the penis is in a state of rigid erection, and occasionally there is satyriasis with seminal emissions.[3] In the female, swelling and heat of the organs

[1] Lissonde, op. cit. [2] Wibmer, Wirkung, etc., iii. 264.

[3] Cases have occurred in which the erotic madness has reached a frightful degree. Such an one is that related by Cabral of a man who had taken a poison containing two drachms of cantharides to cure him of a quartan ague, "ce qui le rendit si furieux à l'acte vénérien que sa femme nous jura son Dieu qu'il l'avoit chevauchée dans deux nuits quatre-vingt et sept fois sans y comprendre plus de

of generation have been observed, and during pregnancy abortion is apt to be produced. It has repeatedly happened that the genital organs have been attacked with gangrene, even in cases in which no sexual excitement was manifested. Indeed, venereal excitement is a symptom of rare occurrence even in fatal cases of poisoning by Spanish flies. In twenty-five such, collected by Dieu, although priapism was a constant symptom, sexual desire was very rare. It is a peculiarly interesting fact brought to light by Schroff that cantharidin does not excite voluptuous sensations nor erections, while ten drops of the tincture of cantharides may produce both phenomena in a marked degree. Bretonneau had already noticed the former fact. Fumouze relates[1] that while subliming cantharidin the fumes escaped through an accidental opening, and were inhaled by himself and two men who were working in the laboratory. M. Fumouze suffered a violent inflammation of the nasal and pulmonary membranes; the others experienced the same effects, together with irritation of the eyes, and a severe cystitis. None of the persons observed any venereal excitement. Lissonde[2] relates that during his prolonged investigations of cantharidin he suffered precisely the same symptoms as those just described, while cantharides in substance displayed an aphrodisiac power. This latter quality he ascribes to the essential oil which the insect contains, from which it derives its characteristic pungent and nauseous odor, and which, he suggests, like the essential oils of rue, savine, and absinth, exert a special action upon the genito-urinary organs. Hence it is wrong to conclude, as has been done, that the suffering and alarm occasioned by cantharidin neutralize its aphrodisiac operation. This operation, according to Schroff, is due to the volatile oil which in the living insect is most abundant at the coupling season.

To the symptoms above detailed, may be added those of general excitement, a frequent small pulse, quick breathing, heat of skin, vascular injection of the face and eyes, thirst, pain in the head, delirium, trembling, universal tetanic spasms, and subsequently coma. According to Dieu, the symptoms of stimulation, if they do not prove fatal, are followed by striking evidences of sedation. There is a general sense of coolness or a copious and cool perspiration; the patient feels inexpressibly prostrated; his eyes are dull, sunken, and surrounded by a dark circle; the features are expressionless; giddiness, faintness, or complete swooning ensue, and there may be vomiting or diarrhœa. It is evident, however, that such symptoms cannot fairly be ranked with the proper and peculiar effects of cantharides; they are such as follow all violent excitement accompanied with severe pain. A case is recorded[3] in which ten soldiers partook, by mistake, of a quantity of tincture of

dix qu'il s'estoit corrumpu; et mesmes, dans le temps que nous consultasmes le pauvre homme spermatisa trois fois à notre présence, embrassant le pied du lict, et agitant contre iceluy, comme si c'eust esté sa femme."

[1] De la Cantharide officinale, Thèse, 1867. [2] De la Cantharidine, 1869.

[3] Bull. de Thér., lxxix. 235.

cantharides, which had been mixed with coffee. The symptoms were such as have been described above, and, in addition, during convalescence from the illness, which lasted for about a week, several of the men had incontinence of urine, and some a degree of paraplegia, with slight muscular cramps and formication in the lower extremities.

The quantity of cantharides required to destroy life cannot be accurately fixed. The smallest dose known to have had this effect, was twenty-four grains taken in two doses; but the patient was a pregnant female, and abortion was produced. An ounce of the tincture has destroyed life, but only after the lapse of a fortnight.[1]

The effects of *cantharidin* do not include so many symptoms of direct irritation as those above described. A pupil of Giacomini took five-eighths of a grain of this substance. Soon afterwards the pulse had fallen from 63 to 57; there was a desire to urinate, with pain in the tract of the urinary organs. General *malaise* followed, with some confusion of the mind, prostration, faintness, a sunken and dull countenance, cold sweats, vomiting, suppression of urine, and a pulse of 45. A glass of wine revived the strength partially, yet only for a short time; an hour and a half later the symptoms reappeared, and the pulse fell to 30. Feeling greatly alarmed, Giacomini administered rum in small quantities until half a pint of it had been taken. Under its influence the symptoms gradually improved, but no sign of alcoholic intoxication followed. Several days elapsed before the experimenter regained his appetite. Pullino,[2] who took four grains in doses of one grain each, and at short intervals, experienced symptoms almost identical with the above, but much less severe. He also found relief in a glass of brandy, to which he added ammonia.

Externally.—When cantharides are applied in an ointment to the skin, there is produced, after the lapse of one or more hours, some degree of redness, a feeling of numbness in the part, and afterwards a stinging and burning pain, which is not, however, apt to be severe unless it is aggravated by the contact of external objects with the inflamed skin. After a longer time, varying with the natural delicacy of the skin and its degree of previous irritation, a number of vesicles arise which subsequently coalesce so as to form bullæ, or it may be a single large cavity containing serum. This fluid is of a pale yellow color and has a faint taste and smell, is alkaline in its reaction, and consists chiefly of water holding in solution some albumen and animal matter with a small proportion of salts. The adjacent cutis is seldom discolored. On removing the epidermis, and allowing the fluid to escape, the chorion is found to be of a pale red color, and its papillæ are rather prominent. The serum which bathes it gradually thickens and dries, and forms a slight pellicle, which, on exfoliating, leaves the skin sound beneath. If the action of the blister is more energetic, the chorion becomes inflamed, and is coated with a fibrinous layer

[1] Am. Journ. of Med. Sci., i. 368. [2] STRUMPF, Handbuch.

which can generally be removed with ease, but is soon formed again, and gradually grows firmer and more adherent. If now allowed to heal, this deposit shrivels, dries, and finally exfoliates, leaving beneath it a new epidermis, through which the skin looks red and feels delicate to the touch. If a blister is applied to a part furnished with hairs they fall out, but are reproduced in the course of two or three weeks.

When a blister is of large dimensions, and is permitted to remain until the occurrence of full vesication, strangury and the other constitutional effects of cantharides sometimes ensue, such as pains in the loins, colic, thirst, micturition, ardor urinæ, hæmaturia, etc. Cases of death from the operation of a blister are recorded.[1] When applied near the origin or over the course of lymphatic vessels, the corresponding glands are apt to become swollen and inflamed, and may even suppurate. The action of the absorbed cantharides is further shown by a pellicle which generally covers the urine during the full vesication of the skin, and is sometimes quite thick. This pellicle is probably albuminous and fatty, and the urine on the application of appropriate tests is found to contain albumen in many cases when the blister has been too long applied, or is too large, or, as sometimes is carelessly done, placed over the recent incisions made by the scarificator in cupping. If the blister remains long applied, it may, as already mentioned, occasion profuse suppuration, erythematous or erysipelatous swelling, unhealthy granulations, and even gangrene. It may also give rise to an eczematous or ecthymatous eruption in the neighborhood, which has been known to spread itself over the whole body. In some cases anthrax has been developed under the application of a blister, but, perhaps, only during an epidemic tendency to that form of disease. It must not be omitted to mention that blisters occasionally seem to have a poisonous action, producing a high degree of fever and nervous excitement. But the precautions recommended to be taken in their use, in the present article, are sufficient, it is believed, to obviate all unpleasant consequences.

Cantharidin is singularly rapid in its action when applied to the skin. According to Robiquet, one-hundredth part of a grain produced vesication in a quarter of an hour when it was rubbed upon the lip. Paper saturated with a solution of this substance in oil, produces vesication in about six hours. The ethereal solution also vesicates very rapidly, as well as that prepared with collodion, etc.

After death from the poisonous action of cantharides, congestion of the brain and a serous effusion on its surface are generally found. Sometimes the peritoneum is inflamed, and the stomach, intestinal canal, kidneys, bladder, ureters, and urethra are generally so. The intestinal mucous membrane is readily separable from its connections, is often stained with blood, and sometimes gangrenous.

Remedial Employment. *Internally.*—The internal use of cantharides is indeed far less general and also less important than

[1] Guibourt, Abeille Méd., xv. 153.

the external, but it is apt to be too much overlooked by practitioners. Among the conditions laid down as appropriate for their use, are torpor and atony of the system and an excessive mucous secretion from the bowels. These indications exist in *typhoid fever*, for which disease the tincture of cantharides has been recommended in conjunction with wine whey and other stimulants. It is probable that all of the good of this combination, without any of its evils, would be accomplished by the vinous stimulant alone. A striking illustration of the stimulant power of cantharides is afforded by the influence of the tincture in a case of *asthenia*, with nervous excitement and delirium, occurring in a man laboring under pulmonary consumption. Sedative measures aggravated the symptoms, which, however, yielded to the repeated administration of tincture of cantharides in doses of forty minims, and the patient was restored to his former degree of health, without the occurrence of any strangury.[1]

A certain number of cases of *dropsy* cured by the internal administration of cantharides are recorded, by the earlier writers especially. But the method does not seem to have commanded general confidence, and the vouchers for its efficacy are not, with few exceptions, authoritative names. Richter would restrict it to those cases which are distinguished by a torpid state of the system. Ferriar[2] refers to several cases of general dropsy occurring for the most part after scarlet fever, in which the medicine, associated with cinchona, effected a cure. Blackall[3] mentions that the powder of cantharides in doses of from one-quarter of a grain to one or two grains, had been recommended by Lieutaud, and is asserted by him to form the basis of an active empirical remedy for dropsical affections.

Many writers recommend the internal use of cantharides in *chronic bronchial affections*, under very nearly the circumstances in which balsamic medicines are useful, but they are inferior to these, and, indeed, of doubtful utility altogether. Even in acute inflammatory diseases of the lungs, the followers of the Italian contro-stimulant school have administered cantharides internally, and, as they declare, with the happiest effects.[4] But their statements are much in need of confirmation.

The success of tincture of cantharides in the treatment of *chronic eczema*, particularly in females, is characterized by Cazenave as surprising.[5] He directed at first three, and afterwards five drops every morning in some demulcent drink, and every week increased the dose by five drops. Wilson advises the medicine to be exhibited along with equal parts of compound tincture of camphor and tincture of cinchona.

Psoriasis, that has returned without assignable cause, and affects persons of an indolent constitution, and also occupies a large surface and has resisted the influence of purgatives, sometimes yields with singular rapidity to the tincture of cantharides.[6] The patient

[1] Am. Med Times, v. 230.
[2] Med. Histories, p. 206.
[3] On Dropsies, 180.
[4] Mendini, Annales de Thérap., vi. 15.
[5] Mal. de la Peau, p. 95.
[6] Ibid., p. 313.

should be restricted to a very methodical diet. Cazenave states that he has seen one who, after suffering for eighteen years from this disease, was cured in a month by the remedy under notice. The same author recommends it also for Grecian *elephantiasis.* Rayer is of opinion that no other remedy possesses so remarkable an influence over psoriasis, but he objects to it on the ground of its liability to produce strangury, particularly in females, and to derange the digestive functions. Of the same affection Mead had long before said, "I am convinced from experience that there is not a better medicine known against this filthy disease than tincture of cantharides."[1]

The older writers furnish numerous examples of the usefulness of cantharides in *chronic affections of the urinary passages* in which the secretion or the discharge of urine is impeded. The work of Greenfield contains many of these which would probably now be described as instances of chronic pyelitis and vesical catarrh. Although modern experience does not in general countenance this use of the remedy, there seems to be no reason why it should not be applicable under the same conditions in which terebinthinate preparations are now employed. Debility or *paralysis of the bladder* has been successfully treated by the internal administration of cantharides, as well as by blisters applied to the sacrum. The former method has also been employed to relieve *incontinence of urine*, as well as *retention* of urine, arising from paralysis of the bladder. The nocturnal incontinence to which children are subject is also stated to be amenable to this remedy. An interesting case occurred to Pereira; it was that of a boy fourteen years old who had been subject to incontinence of urine from infancy. By means of gradually increased doses of the tincture of cantharides he was entirely relieved of the incontinence by day, but the nocturnal discharge continued. The *dysury* of old men, which very generally depends, in part at least, upon debility of bladder, may to that extent be relieved by the medicine under notice, but the danger of its aggravating the inflammatory condition of the lining membrane of the affected organ must not be overlooked. Lisfranc cured a case of *vesical paralysis* by introducing tincture of cantharides into the bladder by means of a catheter. One drop dissolved in lukewarm water was at first injected twice a day and for several successive days, each dose being increased by one drop.[2] Some cases of *diabetes insipidus* appear to have been cured by this medicine.

Writers are not wanting who report having cured *gonorrhœa* by means of cantharides. Bartholin employed a vinous preparation for this purpose, and the same practice was extolled by Werlhoff, Mead, and Robertson. Yet the method has never obtained general acceptance. Chronic or subacute gleety discharges have undoubtedly been arrested by cantharides given in appropriate doses, but the method has less to recommend it than others in common use. Pereira, however, states that he found equal parts of the

[1] Med. Works, p. 455. [2] Lancet, May, 1843.

muriated tincture of iron and tincture of cantharides a successful combination in gonorrhœa of long standing. Doubtless by thus substituting an artificial and temporary stimulation for a morbid and permanent one, the latter may be dissipated. In fact, nearly all of the direct and active remedies for gonorrhœa may be presumed to operate in this manner.

Burdach, after the example of Adair, recommends the internal use of the tincture of cantharides and of aloes for *amenorrhœa*.[1] The cases in which it seems to be most useful are those in which the suppression of the catamenia is connected with a leucorrhœal discharge. J. Murray states that it has been employed as a stimulant in amenorrhœa. The late Prof. Chapman, in a note to Burns' Obstetrics, remarked as follows: "In suppression of the menses evidently connected with atony of the uterus I have had some success with the tincture of cantharides. I give it in a dose of ten drops morning, noon, and night, gradually increasing the quantity till it amounts to two drachms in the day. The most obvious effects of this medicine which I have observed are an increase in the force of the pulse and a very copious flow of urine." In 1819, Dr. J. Klapp, of Philadelphia, published[2] a series of cases, nineteen in number, which demonstrated the power of cantharides to restore the suspended catamenia. He found the medicine most useful in cases of torpor of the system, or where excessive action had previously been reduced by depletion, and he attributed its curative effects to the irritation which it occasions in the bladder and rectum and through them in the adjacent pelvic viscera. He directed the medicine in doses at first of fifteen drops three times a day, and gradually increased the quantity to 30 or 40 drops at each dose.

When the *sexual propensity is feeble*, or quite suspended, particularly as a result of long-continued and passive seminal emissions, the cautious use of cantharides has sometimes succeeded in curing the infirmity. Yet the practice is not without danger, for it is ascertained that the males of several species of quadrupeds become diseased when cantharides are administered to them for the purpose of stimulating the sexual powers.[3]

A large number of authorities assert the power of cantharides to cure *hydrophobia*, and their assertions have been undeservedly discredited by those who supposed the disease just named to be always identical with rabies canina. Hydrophobia is indeed an almost constant symptom of rabies, but it is not exclusively so. It occurs quite frequently in various hysterical, nervous, febrile, and organic affections.[4] The recorded cures of this affection by cantharides do not throw much light upon the nature of those forms of disease to which the remedy is applicable. The greater number of writers, who, like Wichmann and Rust, have vaunted the antihydrophobic powers of cantharides, founded their favorable opinion,

[1] System de Arzneim, iii. 107.
[2] Am. Med. Recorder, ii. 37.
[3] Mérat and De Lens, op. cit., iv. 312.
[4] Rush's Essays, ii. 193.

so far as canine hydrophobia is concerned, upon the prophylactic virtues of the medicine. So fallacious a test is unworthy of serious consideration.

Externally.—The indications for the use of blisters are very numerous if regard be had to the great number of morbid conditions which they are adapted to cure, but the following enumeration includes, perhaps, all of the important cases. Fly blisters may be employed—1st. To stimulate the system generally; 2d. To promote the absorption and prevent the accumulation of certain morbid deposits; 3d. To recall suppressed discharges; 4th. To promote a favorable issue of internal disease by an external counter-irritation or discharge. Cantharides have been used in conjunction with *rubefacients* in order to heighten their effect; with soap liniment, or oil of turpentine, for example. But, except as a very local stimulant, they are much less to be recommended than many other agents. The ointment has been employed to excite *suppuration* in wounds supposed to be poisoned. The powder has also been used for *toothache* by being introduced into a carious cavity. The ointment is frequently prescribed in a diluted state as a dressing for blisters, to promote their suppuration, and also to stimulate and promote the healing of indolent *ulcers*, and especially of *fistulæ* and other sinuses. "Dupuytren's" ointment for *alopecia* contained tincture of cantharides associated with acetate of lead and Peruvian balsam. Other formulæ of the same character have been recommended by various writers on cutaneous diseases. A convenient one is the following: ℞.—Cologne water f℥j, tincture of cantharides, f℥iss, tinctures of rosemary and of lavender, of each, 10 drops. The scalp should be gently rubbed every day with a piece of flannel moistened with this lotion.

Hemorrhage.—A blister on the back of the neck is sometimes serviceable in *epistaxis*, and one between the shoulders, when *hæmoptoë* becomes alarming from the quantity of blood discharged. In *apoplexy*, after the use of general and local depletion has relieved the brain from pressure, a blister on the nape of the neck is of the highest utility, completing the restoration of the patient's senses, if they still remain obscured, by promoting the absorption of the effused fluid. In *congestion of the brain*, whether arising from a plethoric state of the system or from the use of narcotics, or in the course of any disease, blisters can scarcely be dispensed with.

Dropsy.—In general dropsy, blisters applied to the lower extremities have sometimes evacuated the whole effusion. But the method is a hazardous one on account of the danger of producing gangrene. In dropsy of the brain, the application of a large blister to the shaven scalp has not unfrequently caused at least a temporary relief. Some allege it to have effected cures, but the evidence in favor of this assertion is not satisfactory. Johnson cured *hydrocele* by means of blisters applied to the scrotum.[1]

Fevers.—The usefulness of blisters in some among this class of

[1] Edinb. Med. and Surg. Journ., x. 21.

diseases is second to that of no other remedy. The most eminent and experienced writers concur very nearly in their opinions upon the subject, and daily observation confirms their soundness. In continued fevers with a tendency to sopor or delirium, says Freind, more persons have been cured by blisters than by any other method, "nay, one may solemnly aver that more people have been recovered by them than by all the rest."[1] A statement of Baglivi is very much to the same effect. In fevers, he remarks, accompanied with a very low pulse, cold extremities, anxiety, and tendency to coma, "it is incredible what benefit is reaped from blisters." Cullen[2] says, that they may be employed at any stage of continued fever, but that they are most beneficial in its advanced stage, when the reaction is weaker and their stimulant effects can do no harm. Hence, according to this author, the place of their application is indifferent except when a topical inflammation or congestion exists, in which case he admits that the blister should be as near the seat of the affection as possible. According to Percival,[3] blisters are indicated in low nervous fevers, when the spirits sink, when the contractions of the heart grow languid, and the patient struggles under anxiety, restlessness, delirium, difficulty of breathing, and oppression about the præcordia. But in the malignant fevers for which Riverius and Ettmüller extolled them, he thinks that their use demands great caution on account of the dissolved state of the fluids. It was, however, in these very fevers that other writers besides those mentioned eulogized blisters. The appearance of petechiæ constitutes the main indication for their use according to Monro, and Pringle directed them for the double purpose of relieving the brain and stimulating the general system.[4] The precepts of the late Dr. Graves are the fruit of a large experience and a sound judgment, and they conform very closely to those just referred to. According to him, blisters have an important office in typhus (*t. petechialis*) as stimulants.[5] To fulfil it they should be used as *flying* blisters, that is to say, they should be applied for only two or three hours in the same place, and moved from one part of the body to another. Their usefulness when thus employed is very great if the powers of life are much depressed, the action of the heart feeble, the pulse weak, the respiration short and imperfectly performed, and there is a tendency to faintness and sinking. In these cases vesication ought to be so slight that the skin shall seem to be covered with a miliary eruption. But in continued fevers the evacuant action is also important, as well as the sedative influence which depends in part upon the former through the quantity of serum lost, also upon the depression which always follows excitement, and to some extent, it may be, upon the sedative action of the absorbed principle of the cantharides themselves. In the former case the primary and more transient operation of the remedy is sought, but in the latter its

[1] On Fevers, p. 141.
[2] Works, i. 634.
[3] Essays, i. 130.
[4] Diseases of the Army, p. 275.
[5] Clinical Medicine, p. 80, etc.

secondary and remote influence. To obtain this effect, blisters must vesicate freely. The proper conjuncture for employing them for this end is very distinctly described by Graves, as follows: "When you find a patient in fever lying constantly awake, or when, on the contrary, you find him continually slumbering, when there is a certain quickness of manner and irritability, and when the cerebral respiration has been noticed for some time without any concurrent debility or pulmonary disease, under such circumstances, you may, in cases of maculated typhus, predict the approach of cerebral symptoms, and the period about which they generally manifest themselves is the eighth, ninth, or tenth day. Now in cases of this description your best plan will be to shave and blister the whole scalp." Such extensive blistering is believed not to be necessary. Confined to the nuchæ and occiput, the application is all-sufficient, under the circumstances described.

In the other principal form of sporadic continued fever (*typhoid*), the utility of blisters is far from being so decided. The most authoritative writers accord to them a very inferior place in the therapeutics of this disease, and some discard them from its plan of treatment altogether. The observations of the writer lead him to a somewhat different opinion. He is persuaded that, when in this disease ataxic symptoms begin to be replaced by those of adynamia, a blister to the nape of the neck will sometimes cut short the downward career of the attack; and further, that when a tendency to delirium manifests itself early in the disease, a like application will usually arrest the full development of this symptom. Again, when at whatever stage indications of cerebral effusion or intense venous congestion occur, no remedy is so powerful to remove them as blistering, especially after local depletion by cups or leeches. The application of blisters to the abdomen, which has been advised by some persons, we should greatly hesitate to recommend, unless the diarrhœa were excessive. In that case, and when at the same time the accompanying adynamia is very great, we believe that a large blister, applied for four or five hours, is often essentially serviceable, and may be used to restrain the discharge with much less risk than opiates or astringents.

In the sthenic stage of fevers blisters are injurious, and in this opinion all sound authorities are agreed. The expressions of Hoffmann, Baglivi, Alpinus, Pringle, Huxham, Whytt, Percival, Lind, etc., are very emphatic on this point. Yet from the observations of these writers, and of others, it may be inferred that, although the general rule not to apply blisters during the stage of augment in any fever is on the whole sound, yet their local and derivative action may become of such capital importance for the purpose of combating some intercurrent inflammation or congestion, as to overrule the more general precept.

Blisters have sometimes been used as stimulants to favor the development of the eruption in *exanthematous* diseases, or to recall it when it has receded from the surface. They have also been employed to prevent the paroxysm of *intermittent fever* by being

applied to the epigastrium two or three hours before the expected attack.

Affections of the Head.—In all affections of the head, whether of a congestive or an inflammatory nature, blisters form an essential part of the treatment, whether they act by unloading the cerebral vessels, or as a stimulant to the nervous system. In cases where an effusion into or upon the brain, or softening of this organ is indicated by the occurrence of convulsions, low delirium, impairment of the mental faculties or the senses, paralysis, etc., the advantages of these remedies are unequivocal. As a general rule, they ought not to be employed during febrile excitement, nor without either general or local bloodletting. In cases of profound stupor, the blister should be applied to the whole of the shaven scalp as well as to the nuchæ.

Ophthalmia.—Velpeau at one time recommended the application of blisters to the external surface of the upper eyelid as well as to the adjacent skin in the early stage of this disease. But the method does not appear to have been adopted. More usually these counter-irritants are applied behind the ears, to the nape of the neck, or upon the forehead; sometimes also upon the arm of the affected side.

Inflammations of the Lungs, etc.—Graves was, it is believed, one of the first to advise a mode of using blisters which relieves them from the injurious imputations which many writers upon the affections under notice have preferred against them.[1] Nothing, indeed, can be more painful and vexatious to a person suffering under pleuritic or pulmonary inflammation, than a large surface of the chest made raw and suppurating copiously under a blister applied for twelve or eighteen hours at a time. Such a method might well be suspected of tending to aggravate the internal disease. But the same plaster applied for the space of two, three, or four hours only, and followed by a dressing of carded cotton, or of simple cerate, gives but little pain, and is far more salutary than deeper vesication. Nor is it at all necessary that the bullæ, unless very large, should be emptied of their serum, and in no case need the cuticle be removed so as to expose the raw cutis, a process which usually gives rise to severe and exhausting pain. As regards pulmonary inflammation occurring independently of idiopathic fever, the utility of blisters is far from being equal in all its forms. When *pleurisy* has passed the acute stage, there can be no doubt of the usefulness of blisters applied to the chest in removing the effused fluid. But the period during which they are useful is a brief one. When once the effusion has become stationary and the acute symptoms have entirely disappeared, blisters are of comparatively little avail. They may, however, be tried before resorting to other methods, and their action should be somewhat prolonged and sustained. *Pneumonia* is, on the whole, less favorably affected by blisters. Rasori and Laennec regarded them as nearly useless; Louis showed that they do not appreciably affect the duration of

[1] Op. cit., p. 102.

the disease, and Grisolle proved very conclusively, in addition, that the symptoms of pneumonia very seldom subside soon after the full revulsive action of a blister. Rilliet and Barthez arrived at the same conclusion as regards this disease in children, and Dr. West has been led to abandon the use of blisters entirely. Dr. J. F. Meigs is more disposed to attribute good results to them when judiciously managed, *i. e.*, when they are applied for an hour and a half only, and a mild dressing is employed.[1] Without impugning the conclusions arrived at by nearly all of the cautious and sagacious observers just referred to, it may still be confidently asserted that one of the most distressing symptoms of thoracic inflammation, in its early stage, the stitch in the side, is generally removed at once and permanently by vesication. Grisolle, indeed, refers to the continuance of this pain during the convalescence from pneumonia, and to the efficacy of blisters in removing it. It must also be borne in mind that the above-named writers, when they condemn blisters in pneumonia, have in view the mode of using them to which they were accustomed, of applying them during many hours at a time so as to produce extensive suppuration. That such a method would be not only useless, but mischievous, is highly probable, apart even from positive evidence of the fact. But the bad effects of this plan form no objection to an appropriate use of the remedy. Nor is it certain that blisters do, under all circumstances, aggravate pulmonary inflammation. Their stimulant effects, which appear to be dreaded by some authors, do not, in the judgment of others, exist when the plaster is of large size, and judiciously employed. Gendrin, for instance, maintained their great utility in the disease before us. But his mode of using them was not the received one among his colleagues. He was in the habit of prescribing very large blisters (six or 8 inches square) to the chest, and generally with a favorable effect. But such blisters must not be allowed to suppurate; their wholesome action, both revulsive and depletory, ceases within a few hours, and hence they should be healed as rapidly as possible with raw cotton, or a dressing of lead cerate. Gendrin regarded this method as to a considerable extent a substitute for bloodletting.[2] The observations of the writer, who has been accustomed to vesicate after the fashion here described, lead him to the conviction that blisters do exert a favorable influence on the course of thoracic inflammation in robust subjects, allaying the cough and pain, lessening the expectoration, and reducing the tension and frequency of the pulse. The most appropriate time for blistering is when the first is passing into the second stage of pneumonia. At this period the stimulant influence of the remedy is important for reviving the strength of the patient, and aiding the use of internal stimulant diaphoretics which are appropriate to the same condition. Some persons have preferred applying blisters upon the front of the chest, even when the posterior portion of the lungs is inflamed, because in this situation they are said to be less painful.

[1] Diseases of Children, 2d ed., p. 173. [2] Bull. de Thérap., xliii. 367.

The reason is not conclusive. With appropriate dressings, a blister upon the back or side is not more painful than one upon the front of the chest. It is, perhaps, even less so, for the movements of the latter part in breathing and coughing are by much the most extensive.

The employment of blisters in acute pulmonary affections arising in the course of other diseases, and especially of continued *fevers*, is a measure of extreme importance, but one which calls for caution and discrimination. Nothing can be plainer than that the only need of a blister under these circumstances is derived from its power as a stimulant, whereby it gives a more vigorous activity to the pulmonary nerves and bloodvessels and muscles, exciting expectoration, and thereby removing a mechanical hindrance to recovery, quickening the circulation, contracting the capillaries, lessening the amount and improving the quality of the secretion from the air vesicles and minute bronchia, and promoting the absorption of exudations. To attain these objects the blisters must stimulate and not spoliate, must arouse and not depress—must, in one word, exert those powers to which we have so often alluded as being developed only by a comparatively transient operation of the remedy. It is in this way that secondary *pleurisies*, *bronchites*, and *pneumonias* may be prevented from running a fatal course in fevers of a low type, especially if stimulant vesication is supported by internal stimulation.

The *stitch in the side*, which is so frequently a symptom of pulmonary consumption, and which is sometimes pleuritic and sometimes neuralgic in its character, is very generally removable by the application of a small flying blister over the seat of the pain. In *chronic bronchitis*, either in its simple form or complicated with pulmonary emphysema, large blisters to the chest afford decided relief, as well by diminishing the expectoration, when this is excessive, as by relieving the dyspnœa which may be present. Blisters, judiciously employed, seem to have some influence in retarding the progress of *pulmonary consumption*, when a succession of them is applied over the seat of the deposit, and particularly when this exists at the summit of the lung. The pitch plaster with flies is a common application for the purpose. It may, indeed, be doubted whether this mode of treatment exerts any direct influence on the process of tuberculization, but it very probably controls the slow inflammatory process which is constantly going on around the tubercles, or independently of them in pneumonic phthisis, and in that manner retards the progress of the disease. Not impossibly, it may also moderate the activity of the tuberculous secretion itself.

Inflammations of the Heart and Bloodvessels.—It is objected to the use of blisters in *pericarditis* that they interfere with the physical examination of the heart. The only question should be whether they do good. Of this no doubt can exist. Blisters should therefore be employed so soon as the disease is clearly diagnosticated, and local depletion by cups or leeches has been employed. The

mode of using them should be that prescribed for all inflammatory affections in this article. Apart from the proper benefit arising from the blister, the collateral advantage it affords of presenting a surface by which mercurials can be introduced into the system is one not to be slighted.

In *phlegmasia alba dolens*, occurring as a consequence of parturition, blisters have been highly recommended, when applied to the calf of the leg or the ham. *Phlebitis* resulting from venesection was successfully treated by Physick by means of a small plaster of simple cerate spread on linen, over which was applied a blister large enough to cover the whole inflamed part, and extending from the wound in the vein three or four inches in every direction.

Blisters are extremely useful in *chronic fluxes of the bowels*, and even in subacute inflammations of these viscera. But they require judicious management. In the emaciated and exhausted condition which these affections, when chronic, commonly produce, the infliction of pain is to be avoided, and hence blisters, when applied, should not be allowed to remain until full vesication occurs. They should, however, be large enough to cover a considerable portion of the abdomen, if the strength of the patient is not greatly exhausted. If the discharges are very frequent and debilitating, such a counter-irritant application will generally moderate and sometimes arrest them, particularly if, in the absence of fever, gentle stimulants are administered internally.

Diseases of the Skin.—From a very early period the method has been pursued of endeavoring to convert chronic into acute affections, of the skin, and, by thus modifying their degree of activity, to render them more curable. Hippocrates used cantharides in an ointment, destined for the treatment of indolent ulcers. Celsus combated obstinate papular eruptions by the same means. Galen directed a mixture of cantharides and hellebore for producing suppuration and cure in mentagra, lupus, etc. P. Ægina and Aëtius recommended the same plan, which, in later times, was adopted by Ambrose Paré. Many recent authorities favor it in lepra, psoriasis, and lupus, and amongst them may be mentioned Rayer, from whom these historical references are borrowed. He would restrict its use to cases in which the eruption is of limited extent, but very obstinate, and he also recommends that blisters be applied for a short time only—for two or three hours in general—and renewed according to the requirements of the case. Cazenave entirely condemns the use of blisters in the treatment of lepra; but it is presumed that his remark does not apply to the inveterate and local forms of this disease. Blisters have been recommended as an ectrotic application in the treatment of *zona*. M. Hervé de Chégoin assures us that they abort the eruption, and prevent the pain which is the chief evil of this affliction;[1] but other and authoritative writers have found all attempts futile to arrest the eruption by blisters, or other similar means.

[1] Bull. de Thér., lv. 432.

Petit, of Lyons, used blisters in *erysipelas*, upon the seat of inflammation, but later surgeons have restricted their application to the sound skin in advance of or around the inflamed part. This was a favorite mode of treatment with the late Dr. Physick. But its results are extremely fallacious; idiopathic erysipelatous inflammation is never arrested by blistering. It is not doubted that *erythema* from wounds, etc., may be arrested by stimulant applications; but vesicants are worse than useless for this purpose.

To stay the progress of *gangrene*, blisters have been regarded as among the most valuable resources of art. Cotunnius[1] states that he once saw the lower extremity of a patient laboring under putrid fever become gangrenous, and that the gangrene extended to every part of the legs except those upon which blisters had been applied. The mortification terminated about a finger's breadth from the vesicated skin. Roemer attributed to them the power of arresting this process, and Physick was in the habit of using them successfully for the same purpose, by vesicating all the sound parts in contact with the gangrenous tissues.[2] *Indolent ulcers* are sometimes very happily modified by blisters applied upon their surface, and extending somewhat beyond their edges. After the lapse of three, four, or, according to some, twenty-four hours, the part is found to be highly vivified, and to have lost its previously dull and dry aspect. Mild astringent dressings are then applied, and the blister renewed as soon as the inflammation has completely subsided. Permanent blisters are sometimes employed as *issues* to take the place of some long-continued habitual discharge, which has been cured by nature or by art. An hereditary or constitutional tendency to *apoplexy*, or to any other dangerous consequence of internal *congestion*, renders this, or some analogous measure, of the first necessity. It should, however, be well known that an extremely restricted, or a wholly vegetable diet will usually supersede the necessity of an exutory.

Blisters are sometimes used in the neighborhood of chronic morbid discharges in order to arrest the latter. Thus, *gleet* of long standing has been successfully treated by small blisters applied to the perineum. Mr. H. C. Miles[3] claims that acute gonorrhœa may be speedily cured by the application of blisters to the inner surface of the thighs, or along the under surface of the penis; but he advises at the same time purgation with salines, and in some cases, to complete the cure, injections of a solution of nitrate of silver. Dr. S. Jackson, in 1828, called attention to them as revulsives applied to the sacrum in *leucorrhœa*. Dr. Laycock[4] found the cantharides plaster very efficacious in atony or *paralysis of the bladder*, produced by lying long in bed, or by an habitual use of the catheter. For this purpose the blister should not remain applied longer than two hours. Dr. Jackson published[5] several cases in which the influence of a blister applied to the sacrum was very distinct and efficient in

[1] Eberle, op. cit., p. 483.
[2] Eclectic Repert., iii. 511.
[3] Lancet, June, 1861, p. 605.
[4] Lond. Med. Gaz., March, 1839, p. 899.
[5] Am. Journ. of Med. Sci., ii. 299.

preventing abortion.[1] The same application affords decided relief in *painful menstruation.* It is less severe and more efficient than sinapisms, which are popularly used for this purpose.

Stoll passes for having treated acute articular *rheumatism* with blisters; but the affection for which he employed this method of counter-irritation was sciatica.[2] The first person to recommend these agents in the disease referred to was Dechilly, who made use of large blisters applied upon the affected joints during the acute stage of the attack.[3] He maintained that the articular inflammation was as much a local manifestation of a general disease, as is that of the skin in smallpox, etc., and his object was to overcome the morbid cause by attacking its most palpable phenomena. Although the proposition was advocated by Martin Solon, neither it nor the theory of its use was accepted by physicians, and both were neglected for other methods. But in 1864 Dr. Herbert Davies, apparently without any knowledge that the method had already been brought to trial and condemned, proposed the same theory and advocated a similar treatment of the disease.[4] He regarded it as highly successful when judged by its results, of which he conceived that the most important were its abridgment of the duration of the attack, and the comparative immunity of the patients from heart complications. It is of interest to know that a usual and early effect of the treatment was to render the urine neutral or alkaline, that the temperature of the body declined, that the rate of the pulse was diminished, that the local pains were rapidly and speedily relieved, and that convalescence was soon established. To obtain such results it was found necessary to begin the treatment early, and blister simultaneously every affected joint, or rather the adjacent skin. The same method was tried by Lasègue.[5] He encircled the limb both above and below the affected joint with a band of blistering plaster two or three inches wide, kept it applied for six or eight hours, and then, whether the cuticle had been raised or not, covered the surface with cotton wadding. He affirms that the patients not only did not complain of the pain of the blister, but begged to have the same treatment applied to other joints, so decidedly had they found relief. In 1865, in five cases of acute articular rheumatism of marked severity treated by Mr. Jeaffreson, the relief afforded by blistering was speedy and permanent, the temperature of the body fell rapidly, and no cardiac mischief was developed.[6] The distinguished clinician, Dr. Henry Day, affirms that the blistering method never disappointed him in affording marked and almost immediate and permanent relief, and when employed early, in preventing cardiac complications.[7] Strangury is rarely produced by this method, but, as stated, the urine generally becomes alkaline under its use. Dr. Leishman also testifies to the extraordinary and speedy relief from pain procured by the treat-

[1] Am. Journ. of Med. Sci., v. 547.
[2] Méd. Pratique, ii. 69.
[3] Bull. de l'Acad. de Méd. (1850), xv. 665.
[4] London Hosp. Rep., i. 293; ii. 138.
[5] Arch. Gén., 1865, ii. 531.
[6] Times and Gaz., April, 1865, p. 333.
[7] Clinical Histories (1866), p. 68.

ment in question,[1] and Mr. McGregor adds his confirmation.[2] Finally Dr. Davies, after four years' observation of the effects of this method of treating acute articular rheumatism, professed his undiminished conviction of its superiority over all others.[3] Nevertheless, it does not appear to have been generally adopted, probably because it was assumed to be unnecessarily painful and not more efficient than the treatment by alkalines. The latter reason has appeared to us sufficiently cogent to dissuade us from employing it.

When retrocedent *gout* or rheumatism attacks internal organs, blisters to the trunk and extremities are of capital importance. They are sometimes applied over a joint which has habitually been attacked, to attract thither the disease when it is wandering and irregular.

Diseases of the Nervous System.—Counter-irritation was very anciently employed in *sciatica.* The actual cautery was recommended by several Arabian and by many European physicians of the sixteenth and seventeenth centuries. But Cotugno was the first to employ cantharides as a counter-irritant for the cure of neuralgia in the sciatic and cubital nerves.[4] He applied small blisters upon those points of the limb at which the nerve becomes superficial in its course, points which, as he indeed remarks, the patients themselves indicate as the chief seats of pain. He was led to adopt this treatment as well by his observation of the use of the actual cautery, as by an hypothesis which he entertained in regard to the cause of the pain in sciatica. He imagined that it was caused by a certain acrid matter circulating in the nerve, which he proposed, by means of blisters, to draw out at whatever points the nerve approached nearest the skin. Yet he did not, as might have been expected, from his hypothetical views, keep up a discharge from the blistered surface by means of irritating ointments, but employed fresh butter as a dressing, so that it was healed by the ninth day. Then, if necessary, the blister was applied again. His success was so remarkable as to give him a wide and eminent reputation. Teale was the first to observe tenderness of the dorsal branches of various spinal nerves in many cases of neuralgia, and to find that blisters applied over these branches, even without leeching or cupping, which he generally conjoined, sufficed to remove the pain.[5] It was Valleix, however, who finally demonstrated the applicability of blisters to all forms of external neuralgia, by determining that for every nerve the seat of spontaneous pain is mainly in the superficial points of the trunk of that nerve, and upon its terminal branches; that these points are nearly always tender when pressed upon, and that in three-fourths of the cases the most successful plan of cure, and often the only one required, is methodical blistering. He found, however, as Cotugno had previously done, that often while the blister is rising the pain is in-

[1] Glasgow Med Journ., N. S., i. 260. [2] Edinb. Med. Journ., xv. 304.
[3] Lancet, Feb. 1869, p. 190.
[4] A Treatise on the Nervous Sciatica or Nervous Hip-Gout. London, 1775.
[5] A Treatise on Neuralgic Diseases. London, 1829.

creased, but that afterwards it declines or ceases altogether. He was hence led to content himself with a milder treatment, and directed blisters of about an inch square to be applied upon all the superficial points of the affected nerve where pain occurred spontaneously, or could be excited by pressure with the end of the finger.[1] The writer has now for many years employed this method in almost every case of neuralgia which has come under his care in public or private practice. In no single instance has it failed to mitigate the symptoms surprisingly, and in very many it has alone achieved a cure. Sciatica, more than other forms of neuralgia, is rebellious to this and to all plans of treatment, yet it is more generally amenable to methodical blistering, than to any other exclusive method whatever. The writer has been led to modify still further the plan of Cotugno and Valleix, by reducing the size of the blisters recommended by them, and by abridging the time of their application. In all acute forms of the disease, except sciatica, he has found blisters half an inch in diameter, and allowed to remain applied from one to two hours only, to be amply sufficient for effecting a cure. A mild dressing is followed by a rapid healing of the sore, and in less than a week the application may be renewed if necessary.

Convulsive diseases, especially of late years, have been extensively treated by means of blisters applied to the "centre of excited motion," the spinal marrow. It is unnecessary to enumerate all of the particular forms of disease in which this treatment is appropriate. The most important of them, perhaps, is *tetanus*. In this affection, even when of traumatic origin, blistering on either side of the spinous processes, and throughout the entire length of the spine, is an important, if not an essential element of the treatment. It is possible, though not certain, that the endermic use of the salts of morphia on the parts thus denuded adds greatly to the efficacy of the vesication. It were perhaps better to introduce the narcotic by inoculation. In the treatment of *cerebro-spinal meningitis* we have found blisters of very great service under special circumstances. Not in the malignant form of the disease, for in it the gravity of the attack depends mainly upon blood changes, nor very strikingly during the decline of the less rapid form; but in the early stages of the more regularly developed type we have no doubt that they relieve pain in the head, spine, and limbs, and mitigate spasm and coma, and therefore contribute to determine a favorable issue to the attack. *Partial spasm*, as of the abdominal muscles, those of the stomach, of the fingers in what is called scrivener's spasm, of the respiratory muscles in spasmodic asthma, etc., is often relieved by vesication upon or near the affected part. Vesication of the epigastrium is one of the most effectual means of arresting the obstinate *vomiting* which is met with in certain febrile affections and in chronic diseases of the stomach. Alone it often answers the intended purpose, but its efficacy is increased by sprink-

[1] Traité des Névralgies, etc. Paris, 1841.

ling the denuded cutis with a small quantity of a salt of morphia. *Epilepsy* and *puerperal convulsions* are sometimes alleviated by the use of blisters. Dr. Buzzard[1] has called attention to the operation of circular blisters applied upon a limb above the point from which an aura epileptica proceeds in advance of the fit. The various forms of *paralysis* depending upon disease of the brain or spinal marrow are, when the cause is removable, greatly benefited by blisters applied to the nuchæ or along the spine. In that form arising from *muscular atrophy*, as of the deltoid, nothing, except, perhaps, induced electric stimulation, excites anew the development of the muscle so certainly as a succession of blisters. Puerperal and other forms of *mania*, which seem to have arisen in consequence of the suppression of a discharge, are sometimes cured by the revulsive use of blisters.

It has been proposed to evacuate *cold abscesses* by vesication instead of puncture, which, it is well known, may occasion serious results. By applying a blister upon the attenuated skin, the cuticle is removed, the cutis grows thinner, and ultimately allows the fluid beneath it to escape gradually and without the admission of any air. A not dissimilar method has been employed in the case of *buboes*, and, when it succeeds, the unsightly scar left by incision is avoided. Previously to suppuration, these swellings may very generally be arrested in their progress by judicious vesication. For this purpose a blister must not be allowed to remain applied more than two or three hours, and should be renewed as soon as the skin has healed. According to some authorities the method is inapplicable to true syphilitic buboes, and successful in those only which are sympathetic. But since the specific or non-specific character of the inguinal swelling is merely conjectural, so long as it does not form and discharge pus, the attempt to institute an abortive treatment ought always to be made. It is unquestionably successful in a great many cases, when care is taken to make the vesication superficial. It just as certainly hastens the suppurative process when the blister is allowed to remain long applied. *Scrofulous* and other indurated glandular *swellings* are often discussed by the steady and moderate use of blisters.

Administration.—The *tincture* of cantharides is the only preparation which is administered internally, and of this the dose is from ten drops to a fluidrachm two or three times a day, largely diluted by some demulcent liquid. To produce vesication, several preparations have been used, of which the only officinal ones are cantharides paper, cantharides cerate, cerate of extract of cantharides, ointment of cantharides, and cantharidal collodion.

The benefits to be derived from a blister depend so entirely upon its management that a full description of it may be useful in this place. A blister should generally be applied near the seat of disease, directly over it when it is deep seated, and in the neighbor-

[1] Practitioner, i. 226.

hood when it is more superficial. This precept refers to the revulsive action of blisters. Whenever they are employed as general stimulants, the place of their application is indifferent, provided that it be upon a delicate part of the skin, as the inside of the thighs or arms, etc. Many of the older writers direct blisters to be applied for an inordinately long period. One of them (Withers) says "it will generally suffice if the plaster remain upon the part twelve or sixteen hours," but some practitioners, he subjoins, direct them to remain applied thirty or forty hours. A distinguished physician of Paris speaks of a blister having been applied "for the ordinary time, about twenty-four hours;"[1] and another, of equal repute, condemning this prolonged action of the epispastic, remarks that "an application during ten or twelve hours at most would be preferable."[2] Even Pereira gives twelve hours as the usual period requisite for blistering. The late Dr. Graves severely reprobated this custom, which prevailed almost universally so short a time as thirty years ago, and which is still very generally followed upon the continent of Europe. Dr. G. was one of the first among his countrymen to assail the barbarous practice, and to show that four or five hours' application in the adult is sufficient for obtaining all the benefits of blisters in acute diseases, unless the head be the part to which they are applied; in that case they require at least twelve hours to produce their full effect. Still earlier than Dr. Graves, Dr. W. Channing, of Boston, called attention to this point of treatment.[3] "I do not," he remarked, "recollect one case in which full vesication has failed to occur where the plaster has been on a sufficient time to produce distinct redness and incipient vesicles." And he observes further: "Full vesication will follow its application, if for a couple of hours only, even where no visible effects had been produced at the time of its removal; and this the more certainly when a warm poultice or simple cerate is used as a dressing." The statements which have been made above are amply sufficient to account for the various evil consequences which have been observed to follow blistering with cantharides; and the simple mode of preventing them is to avoid the erroneous and unnecessarily prolonged application of the plaster, and to take into account the circumstances and condition of every patient to whom they are applied, the feebleness of the old, the tenderness of infants and children, the depressing and devitalizing operation of epidemics of fevers, and certain chronic diseases, and other influences more fully referred to below. Dr. Channing refers to a practice employed by Odier, of Geneva, in 1811, and which merits attention. It consisted in treating rheumatism by allowing the plaster to remain upon the affected part for an hour only, even although neither redness nor a blister followed. The same plaster was reapplied several times in the course of a day.

Like friction or rubefaction, a febrile state of the system renders

[1] Bulletins, etc., des Hôpitaux, 2ème sér., iii. 234. [2] Bull. de Thér., lxxxi. 539.
[3] N. England Journ. of Med. and Surg., 1826, xv. 288.

the skin more easily vesicated. Hence, as a general rule, the more frequent the pulse and the higher the temperature of the body, the shorter is the time required for the production of vesication. When the skin is delicate, as in children and females, the excessive irritation of a blister may be prevented by causing the officinal cerate to be diluted with lard, or by interposing a piece of fine tissue paper between the plaster and the skin. A proper regulation of the time during which the application is made will generally, however, render these precautions needless. To prevent strangury the most effectual mode is to observe the precepts now so often repeated concerning the duration of blistering. If it be preferred to use camphor for this purpose the most convenient plan is to moisten the surface of the plaster with an ethereal solution of camphor. The ether evaporates rapidly, and leaves a delicate film of camphor spread uniformly over the cerate. Liquor potassa, in the dose of twenty minims, largely diluted and administered before vesication has commenced, is represented to be a very effectual means of preventing strangury. We have strong doubts of the efficacy of either measure.

The form of the plaster must depend upon that of the part to which it is to be applied, and be so modified as to come into close contact with the skin which should first be washed with warm water and soap. Simple friction or friction with some stimulating fluid will also render the skin more apt to vesicate. A sinapism applied for a few minutes will have this effect still more decidedly. It is of comparatively little consequence on what substance the plaster is spread. None answers better than stout brown paper. It is usual, and more elegant certainly to employ kid. In either case the blister may be held in its place by strips of adhesive plaster. Or the cerate itself may be spread upon a piece of the latter, leaving a sufficient margin to insure its firm and complete attachment.

A simple and very convenient dressing for blisters consists in applying a layer of finely-carded cotton to the blistered cutis,[1] after evacuating the serum by punctures or incisions made in the most dependent part. One side of a layer of cotton wadding with the wool towards the skin answers the purpose very well. If the blister is small, this dressing may be left untouched until the skin beneath it has healed. When of larger dimensions, the necessity is greater for more frequent dressings, particularly if the part be one subjected to friction by the movements of the patient. Patent lint may be used instead of cotton, and is indeed preferable when the affected surface is of large extent. So long as the cuticle remains entire, or nearly so, no other dressing than the foregoing is required, but if the raw and inflamed chorion is exposed, a dressing of simple or of lead cerate is better adapted to allay the inflammation and to promote the healing of the part.[2] When a blister is intended to dis-

[1] It was originally recommended by Dr. Merrill, of Natchez.

[2] A favorite dressing with the people, and among country practitioners, consists of fresh cabbage leaves (*Brassica oleracea*).

charge the office of an exutory, this course must be modified. Not only must the plaster remain applied for a much longer time, but the cuticle must be altogether removed at the first dressing, and simple cerate applied for a few hours, after which ointment of cantharides, or basilicon ointment may be substituted. Under their use the discharge generally grows purulent. If it be desired still further to prolong the secretion, mezereon or savine ointment may be used. When the vesicated skin becomes uneven, swollen, and discharges a thin and offensive fluid, and at the same time an erysipelatous blush appears around the wound, cooling and slightly astringent poultices or salves should be applied. The best application for the vesicular or pustular eruption which sometimes makes its appearance around the sore, is a fresh and mild mercurial zinc or lead ointment frequently renewed. A dressing composed of one part of red precipitate ointment with fifteen or twenty of simple cerate, is recommended by Trousseau. The common lime-water liniment, or a diluted solution of the subacetate of lead, is more appropriate if there is much inflammation. If the vesicated cutis assumes an indolent aspect and is covered with large and flabby granulations with little or no secretion, local stimulants must be resorted to. Of these the best is nitrate of silver, but other caustic and stimulant applications may also be used.

Trousseau has directed attention to a probable explanation of the fact that in many persons blisters heal with singular rapidity, and referred it to a law established by general observation, viz., that in some persons wounds of all sorts have the same tendency. In children, as a general rule, the tendency of blisters to heal is very remarkable, but the extremely active state of the nutritive function in early life seems to explain the fact. In old persons, on the other hand, blisters are slow to rise, and their suppuration is scanty and imperfect, while the sore which they leave behind is healed with difficulty. In certain states of the constitution depending upon individual peculiarities, or upon an epidemic influence, blistered surfaces have a tendency to be covered with false membranes. This is peculiarly the case in diphtheria, and during the prevalence of dysenteric affections, particularly in large hospitals. Some persons have indeed regarded the inflammation produced by cantharides as of an essentially diphtheritic nature. Bretonneau demonstrated that an ethereal preparation of cantharides injected into the trachea, or placed upon the lips of dogs, produced an inflammation remarkably like that of croup. But such effects in the human subject are, it is well known, quite exceptional. The false membranes upon blisters are most apt to arise under an epidemic constitution of a typhoid kind. To remove them the most effectual mode is not to use emollient poultices, or to render the dressings less stimulant, but on the contrary, according to Trousseau, when the false membranes grow thicker and more adherent, to apply a blister immediately upon them. These remarks refer to the more perfect membranes; but if the sore become coated with soft, grayish, and pultaceous concretions, exhaling a gangrenous odor, and at

the same time bleeds readily, and is surrounded by an erysipelatous blush, mild and emollient dressings are alone appropriate at first, and such as are slightly astringent and stimulant afterwards. In certain epidemic constitutions, and in certain conditions of the system, blisters are very apt to be followed by furuncles, carbuncles, large abscesses, or erysipelas. These are occasional effects which cannot well be foreseen, but which should lead the cautious practitioner to avoid blistering large surfaces, and to limit the time of application of blisters to the absolute requirements of the case in which they are employed.

The late Dr. Beck, of New York, called particular attention to the modifications required by infancy and childhood in the application of blisters.[1] In regard to its duration, Dr. B. agrees with Evanson and Maunsell, Neligan, Ballard and Garrod, West, J. F. Meigs, and nearly all recent authorities, that as soon as the skin is uniformly reddened the plaster should be removed and a poultice applied. A neglect of this precaution—a neglect like that which formerly prevailed, of allowing blisters to remain applied to children for six or eight hours—is prolific in mischievous effects, violent general excitement, convulsions, exhausting pain, and even gangrene and death when the child is feeble, prostrated by prolonged illness, or suffering from an eruptive disease. In the last-mentioned case the tendency to gangrene is very strong; and if in such a one blisters are judged necessary, they should be applied for the shortest possible time sufficient to produce their intended effects. In all cases the dressing should be of the mildest description, and none is better than finely-carded cotton.

Applications of Collodion with Cantharides.—The chief advantages of this preparation are, that it is more cleanly than the ointment of cantharides; that it may be made to vesicate a smaller surface than the ointment can be conveniently applied to; and that it adapts itself more readily to irregular surfaces. It is, on the other hand, open to the objection that the degree of vesication it produces cannot so easily be regulated, and hence it has sometimes been found to occasion very painful and obstinate sores. It is applied by means of a brush in several successive layers, which should then be covered with a piece of oiled silk, or of sheet gutta percha. It is better adapted to blistering small than large surfaces, and is a peculiarly convenient agent for raising those small blisters which have been recommended in the treatment of neuralgia.

Treatment of Poisoning by Cantharides.—When a poisonous dose of this medicine has been taken, a vegetable emetic should be promptly administered, and other means employed to evacuate the stomach, after which copious draughts of mucilaginous and albuminous liquids should be given, in order to protect the digestive and genito-urinary organs. General warm baths and warm cataplasms to the abdomen may also be prescribed, and emollient

[1] Infant Therapeutics, p. 62.

fluids, if necessary, injected into the bladder and rectum. The enemata may contain laudanum.

It seems clear that however serviceable camphor may be in preventing or in mitigating the irritation of the urinary apparatus, it is useless, if not hurtful, when poisoning has actually occurred. The Italian school[1] recommend wine and other alcoholic drinks, and in severe cases the addition of a small proportion of opium. If the reported cases of the efficacy of such means can be relied on, stimulants are certainly to be preferred to sedatives and emollients in the treatment of the constitutional symptoms. They find an appropriate object in sustaining the nervous system, while diluent drinks tend to correct the irritant action of the poison upon the digestive and urinary organs. Oil has also been much used as an antidote. Whether it does more good by sheathing the particles of the poison, or more harm by affording them a solvent, is still undecided. Solution of potassa largely diluted has also been employed with advantage.

Several other irritants, which may be designated as mechanical, might be introduced in this place. Of these *friction* and *shampooing* are hygienic rather than medicinal procedures; *acupuncture* possesses very subordinate practical interest; and *setons* and *issues* have a more specific relation to surgical than to medical modes of treatment.

MUCUNA.—*Cowhage.* Vid. *Anthelmintics.*

[1] GIACOMINI, p. 149; DIEU, iii. 40.

Class IV.

TONICS.

The preceding divisions of the Materia Medica comprise medicines whose predominant characteristic is their action upon the part to which they are directly applied. Those which we now propose to examine are, on the other hand, distinguished rather by their remote effects upon the economy. While the former appear primarily to affect the physical relations of the particles which compose the tissues, the operation of the latter is first manifested in a modification of the functions of the organs, often without any discernible influence upon their physical condition. Or, to express this difference theoretically, the one division comprises medicines which directly act upon the tissues themselves, but the other those which more immediately modify the composition of the blood, nutrition, and the action of the nervous system. The latter includes tonics, stimulants, and sedatives.

The word tonic is derived from the Greek τείνω, I stretch; and by a figurative allusion to a stringed musical instrument, the cords of which do not give out their proper sound unless made duly tense, tonic medicines may be described as those which gradually produce the requisite degree of tension of the nervous system, or, generally, of the living fibre, and which enable it fitly to respond to all of its natural and appropriate stimuli. The idea of tension is inseparably associated with all our notions of vital force, because the most common, if not the only, conception we possess of organic power is derived from our experience of the phenomena of muscular force, which is always displayed in connection with the tension of muscular fibre.

All exhibitions of force in the animal economy involve a vital and an organic element; the former of which represents the power, and the latter the mechanism by which the power operates. The organ may be fully developed and sound, but the power to move it may be defective; or, on the other hand, the vital activity may be unimpaired or even exaggerated, but from defective or disordered nutrition, the organ may be unable to manifest the power which is expended in it. Finally, neither of these elements may possess the requisite degree of development; the organ may be imperfectly

nourished, and, at the same time, the vital force may be wanting which is required for the performance of its functions.

For these morbid conditions nature has bountifully provided remedies; stimulants to excite and tonics to strengthen, and, as if with an intelligent anticipation of the needs of the system, a third class of medicines which combine the virtues of the other two. Not altogether different in their essential nature, tonics and stimulants do not exclude, but are rather complementary to one another, the former developing the organic nutritive element, the latter the dynamic, nervous, or vital power. According to the necessities of each case of disease, we may employ an exclusively tonic or an exclusively stimulant method of treatment, or combine the two by associating representatives of each class, or prescribing those in which tonic and stimulant virtues are united in different proportions, and which are called tonic stimulants, or stimulant tonics, according to the quality which predominates in each.

Comparing pure tonics and pure stimulants with one another, we are struck with this remarkable difference between them, that while the influence of the latter is transient, that of the former is comparatively permanent. Stimulants, acting upon the nervous system, rob it of power by their very stimulation, and, unless the loss were made up for by an external supply, would soon exhaust it completely; but every tonic operation, under due conditions as regards nutriment, adds to the strength of the system in a slow and gradual, but permanent, manner. Nevertheless, tonics are stimulants of the organic force, and, as we shall see, produce some of the worst effects of stimulants when employed too lavishly, and not in due proportion to the susceptibility of the stomach and of the nervous system. Stimulants are also virtually tonics when, by means of their power over the intensity of organic operations, they enable the stomach to digest food which, without their aid, would be only burdensome and irritating.

Besides the groups of tonic medicines just mentioned, there is another, which may with propriety be called specific, because each member of it presents peculiarities depending upon its essential nature, or upon its association with an element possessed of specific powers. The most important article of this class is iron. Its operation upon the stomach, and, therefore its direct influence upon the function of digestion, is almost inappreciable; and those of its preparations which are administered with a view to this effect owe whatever efficacy they may have in promoting it to the acids with which they are combined. A more correct denomination for iron would be that of a nutrient medicine, for its presence in the blood, and in the solids also, is quite as essential as the elements of ordinary food to the performance of their functions. Cinchona possesses the virtues of a true tonic, and that in a high degree, but its most eminent qualities depend upon quinia and the other alkaloids which it contains, and which impart to it antiperiodic virtues. A similar remark is applicable to willow and dogwood barks, although the specific properties in them are very feeble, and, indeed, according

to some, do not exist at all. Finally, wild-cherry bark contains a bitter and tonic principle combined with a direct sedative, hydrocyanic acid, and affords, it is believed, the only example of this association of apparently antagonistic virtues in the same substance.

Bitter tonics, or those vegetable productions which appear to owe their tonic properties to their bitterness, if taken a short time before meals, excite the appetite, and render the debilitated stomach capable of digesting a greater quantity of food than it could otherwise dispose of. Consequently, under their influence, and provided that the secondary assimilation be not impaired, the muscular strength becomes increased, and all the operations of the economy are more vigorously performed.

The nature of the action excited by vegetable bitters upon the stomach is not well understood; but a consideration of their effects under different circumstances renders it probable that they act as irritants. For if they are used in excessive doses they excite gastric uneasiness, pain, and even vomiting, the latter the more readily if they are administered in warm infusion. Under such circumstances, if not rejected by the mouth, they may occasion colic and diarrhœa. It is also well known that if their dose is not proportioned to the susceptibility of the digestive organs, they may not only cease to produce a tonic effect, but absolutely destroy the appetite and give rise either to diarrhœa or constipation. It is, moreover, a familiar fact that a febrile state of the system altogether contra-indicates their use, because they then immediately derange the stomach and augment the vascular excitement. This is at least true as regards acute febrile diseases. It is even more important in its relation to the present question to bear in mind that when these medicines are administered to persons in full health, they are very far from augmenting the vigor of the system generally or of the organs of digestion. They impair the appetite, derange the functions of the stomach and bowels, coat the tongue, excite headache, and in fact engender the very condition which under different circumstances they are adapted to cure.

It is also to be observed that medicines of various kinds impart activity to the digestive function. Many irritants, it is well known, are used as condiments, and alcoholic stimuli are everywhere employed before and during meals to increase the appetite and promote digestion. Now there is no evidence at all to show that bitter tonics exert any part of their influence after absorption; everything, on the contrary, tends to prove that their action is limited to the mucous membrane of the stomach and bowels. If such be the case, we must look for an explanation of their differences from irritants and from alcohol, chiefly in the peculiarity of the mode and degree of their stimulation. It is evidently gentler than the one, and both gentler and more permanent than either, and hence would seem to be better fitted than either to restore that natural tone to the digestive organs which they have lost through the protracted operation of debilitating causes.

If now we endeavor to learn the cause of this peculiarity in the present class of medicines, and turn as we naturally must to their physical qualities for a solution of the question, we are immediately struck by the quality of bitterness which they possess in common, and are disposed to conclude that in it reside their tonic virtues. Although this conclusion is true, it does not appear to embrace the whole truth. Among crude vegetable tonics the most powerful is quassia, and in it the quality of bitterness resides in an intense degree, yet it is surpassed in bitterness by sulphate of quinia, which is inferior to it in purely tonic qualities. A similar remark may be applied to nux vomica and its alkaloid strychnia, which exceed all other substances in bitterness, but whose tonic virtues, properly so called, have not appeared to us to entitle these medicines to a place in the present class. Aloes and colocynth are also extremely bitter, but are scarcely to be regarded as tonics. These facts, although few in number, are sufficient to prove that the cause of bitterness is not identical with the tonic quality, although generally associated with it. We must not quit this brief notice of an interesting question without referring to an analogy which probably is not without its significance. The bile has a bitter taste, and the importance to digestion of this secretion is very great. It is true that its influence is generally ascribed to its alkaline qualities, and they are doubtless essential to good digestion; but we may not overlook the fact that a bitter secretion is provided by nature to which we may without much risk of error ascribe some share in the activity of intestinal digestion, and hence reasonably infer that the analogous quality in tonic medicines may exert a similar influence upon the function of the stomach.

In regard to the therapeutical applications of tonic medicines, it may be remarked that those called specific have, as their name imports, an application to special diseases; iron to anæmia, or deficiency in the red disks of the blood, and Peruvian bark and its associated barks to periodical, and especially malarial paroxysmal diseases. These vegetable tonics may be more or less applied to the same cases as simple bitters and stimulant tonics.

As it has already been intimated, iron enters into the system to be assimilated and occupy its place in the blood, muscle, etc., as a constituent of the body, while bitter tonics operate primarily and perhaps exclusively upon the stomach and intestine, increasing the appetite, and promoting assimilation of the food. Hence a practical precept arises, of no small importance, when the digestion is feeble and iron is indicated, always to associate with it one of the bitter vegetable tonics. Thus it is that "bark and iron" have long been looked upon as almost inseparable coadjutors in the tonic regimen.

SPECIFIC TONICS.

FERRUM.—Iron.

Description.—Iron is the most abundant and widely diffused of the metals. It forms a considerable proportion of the solid crust of the earth, and probably also of the heavenly bodies, as proved by spectrum analysis, and meteoric stones have been found to consist of it almost entirely. It is found in very many if not all vegetables, and is an essential constituent of the animal organism, where it exists in the blood in the proportion of about one-half a grain in a thousand.

The color and density of iron are too familiar to require description; its ductility is very great. Its sp. gr. is 7.8. It fuses at 2850° F., but at a much lower temperature burns in the air. It is extremely oxidizable in moist air. Heated to whiteness, it decomposes water, and combines with its oxygen. Its combinations are all remarkable for their styptic qualities.

The forms in which iron is prepared for medicinal use are very numerous, and, with some differences arising from the operation, especially of the sulphates, are so nearly analogous in their therapeutical powers, that they may be advantageously treated of under the same general head. Viewed with reference to their composition, they form several groups, which may thus be enumerated: 1. Iron in the metallic state; 2, oxides; 3, combinations with, *a*, mineral acids, and *b*, organic acids; and 4, compounds with halogen bodies.

1. *Preparation of Metallic Iron.*

Ferrum Redactum.—*Reduced Iron; Powder of Iron; Quevenne's Iron; Iron by Hydrogen.*

This preparation, which consists of metallic iron in a finely-divided state, is obtained by reducing the sesquioxide by hydrogen. When this gas is passed over the sesquioxide heated to redness, it abstracts the oxygen of the latter, forming water, which escapes, while metallic iron is left behind. To prevent re-oxidation, it must be carefully protected from the air. Powder of iron is of an iron-gray color, is without taste or smell, and ignites when touched with a lighted taper. When pure, it causes effervescence on being thrown into a diluted acid, because its attraction for oxygen disengages the hydrogen of the water.

2. *Compounds of Iron with Oxygen, and their Preparations.*

Ferri Oxidum Hydratum.—*Hydrated Oxide of Iron.*

A solution of tersulphate of iron is decomposed by the addition of ammonia, and the hydrated oxide is precipitated. It is directed

to be kept, with water, in close bottles, as an antidote for arsenic. It is a reddish-brown gelatinous or pulpy semi-solid, without either taste or smell. When mixed with arsenious acid in solution in the proportion of twelve parts to one of the acid, a very insoluble arsenite of protoxide of iron is formed.

FERRI SUBCARBONAS.—*Subcarbonate of Iron; Precipitated Carbonate of Iron; Sesquioxide of Iron.*

This preparation, which is a hydrated sesquioxide, and not a carbonate of iron, contains, however, a small proportion of the latter compound. It is obtained by precipitation from a solution of the sulphate of iron by means of carbonate of sodium, and afterwards washing and drying the precipitate. By exposure to the air it is rapidly converted into the sesquioxide. It is of a bright reddish-brown color, and is without smell, but has a somewhat ferruginous and styptic taste. It generally effervesces with acids.

EMPLASTRUM FERRI.—*Iron Plaster.*

It is made by adding one part of subcarbonate of iron to eight parts of lead plaster and two parts of Burgundy pitch, previously melted together.

PILULA FERRI CARBONATIS.—*Pill of Carbonate of Iron; Vallet's Ferruginous Pill.*

In order to prevent the conversion of the protoxide of iron into the sesquioxide, noticed in a preceding paragraph, Becher, of Mulhausen, in 1835, proposed the method about to be described; it was subsequently modified by Vallet, who gave his name to the pills which have now become officinal. The method consists essentially in taking advantage of the power of sugar to prevent oxidation, and by its means protecting the iron in each step of the process above described for procuring the protoxide. To the solutions employed, sugar is added, and the precipitate, having been allowed to drain, is mixed with honey and sugar and evaporated to a proper consistence for making pills. They contain half their weight of carbonate of iron. The mass is black, and has a sweet and at the same time ferruginous taste.

MISTURA FERRI COMPOSITA.—*Compound Mixture of Iron; Griffith's Antihectic Mixture.*

This mixture contains myrrh, carbonate of potassium, sulphate of iron, spirit of lavender, sugar, and rose-water, but its efficacy is chiefly due to the iron, which it holds in the form first of the carbonate of the protoxide and afterwards of the sesquioxide. This conversion, which is due to the action of the air, is marked by a change of color in the liquid from green to brown.

PILULÆ FERRI COMPOSITÆ.—*Compound Pills of Iron.*

These pills contain the same active ingredients as the compound mixture of iron, viz., myrrh, carbonate of sodium, and sulphate of iron. By their trituration with syrup a carbonate of the protoxide, which speedily changes to a carbonate of the sesquioxide, is formed.

NATURAL MINERAL WATERS.

Chalybeate springs are extremely numerous. This might indeed be expected from the great abundance of iron in the earth. They may readily be recognized by the rusty deposit upon the stones and the soil which they cover, the iridescent scum that frequently floats upon their pools, and by their ferruginous taste. In these springs iron is generally met with as a bicarbonate, or as a sesquioxide, and in a small proportion of instances as a sulphate. It is, indeed, mainly due to the action of carbonic acid contained in the waters of chalybeate springs that they hold in solution so large a quantity of iron and deposit it as the gas escapes. To the abundant impregnation of many of these springs with carbonic gas a portion of their virtues may be attributed. In all cases the waters contain saline ingredients which doubtless modify, and generally augment, the operation of the chalybeate element.

3. *Compounds with Mineral Acids.*

FERRI SULPHAS.—*Sulphate of Iron; Green Vitriol.*

This salt may be prepared by heating together diluted sulphuric acid and iron wire, evaporating the solution, and drying the crystals. They are transparent rhomboidal prisms of a bluish-green color, and of a sweetish ferruginous and astringent taste. They effloresce on exposure to the air, becoming covered with a powder which is whitish at first, but afterwards grows yellowish or brownish, owing to the conversion of the protoxide into the sesquioxide of iron. Sulphate of iron is soluble in two parts of cold, and more readily still in hot water; but in alcohol it is insoluble. It is decomposed by the alkalies and their carbonates, soaps, lime-water, nitric acid, nitrate and tartrate of potassa, iodide of potassium, borate and phosphate of soda, the soluble salts of lime, lead, and baryta, nitrate of silver, the soluble sulphurets, and, unless perfectly pure, by all the vegetable astringents.

LIQUOR FERRI SUBSULPHATIS.—*Solution of Subsulphate of Iron; Solution of Persulphate of Iron; Monsel's Solution.*

It is prepared by the reaction of sulphate of iron with sulphuric and nitric acid and water, with the aid of heat. "It is an inodorous, syrupy liquid, of a ruby-red color, and of an extremely astringent taste, without causticity. It mixes with alcohol and water in all proportions, without decomposition."

LIQUOR FERRI TERSULPHATIS.—*Solution of Tersulphate of Iron.*

When sulphate of the protoxide of iron is heated with nitric acid, the former is converted into a sesquioxide of iron at the expense of the latter, and on the addition of sulphuric acid a tersulphate is formed. Water enough is then added to make a definite measure. It is a dark, reddish-brown liquid, of an extremely acid and styptic taste.

FERRI SULPHAS EXSICCATA.—*Dried Sulphate of Iron.*

It is prepared by exposing sulphate of iron to heat, gradually in-

creased until it reaches 300° F. It forms a grayish-white powder, almost entirely soluble in water.

Ferri et Ammonii Sulphas.—*Sulphate of Iron and Ammonium; Ammonio-ferric Alum.*

By adding sulphate of ammonium to a solution of tersulphate of iron at the boiling point, the two salts unite to form the sulphate of iron and ammonium. On cooling it deposits octahedral crystals of a pale violet color, with a sour and astringent taste.

Liquor Ferri Nitratis.—*Solution of Nitrate of Iron.*

This preparation is directed to be made by the gradual action of diluted nitric acid upon pieces of iron wire, and by heating the solution. It is chemically a ternitrate of the sesquioxide of the iron. Solution of nitrate of iron is a transparent liquid, of a pale amber color, and astringent taste.

Ferri Hypophosphis.—*Hypophosphite of Iron.*

"A white amorphous powder, insoluble in cold water, and soluble in hydrochloric acid."

Ferri Phosphas.—*Phosphate of Iron.*

This preparation, obtained by the double decomposition of sulphate of iron and phosphate of sodium, is a tribasic salt, consisting of a mixture of the phosphates of the protoxide and sesquioxide of iron with water. Phosphate of iron is a bluish-white powder, insoluble in water, but soluble in diluted nitric and other acids.

Ferri Pyrophosphas.—*Pyrophosphate of Iron.*

This compound is prepared by precipitation from a solution of the tersulphate of iron with the pyrophosphate of sodium, and dissolving the gelatinous product in citrate of ammonia, after which the resulting liquid is evaporated to a proper consistence and spread on plates of glass to dry. "As thus prepared, it is in thin apple-green scales, having a slightly saline (not metallic) taste, wholly and freely soluble in water." (*Parrish.*) *A syrup of pyrophosphate of iron* may be made by dissolving the pyrophosphate of iron in simple syrup, in the proportion of sixteen grains to the fluidounce.

4. *Compounds with Organic Acids.*

Ferri et Potassii Tartras.—*Tartrate of Iron and Potassium; Tartarized Iron.*

This double salt is prepared by heating together hydrated oxide of iron and a solution of bitartrate of potassium. The solution is then evaporated to a syrupy consistence, and spread upon plates of glass or porcelain to dry. As thus obtained, it is in transparent, glistening scales of a ruby or dark red color, which are readily soluble in water. It has a very slightly styptic and acid taste.

Under the name of *Wine of Iron* (Vinum Ferri, *Lond.*) a preparation is made by digesting an ounce of iron wire in two pints of Sherry wine for thirty days. The bitartrate of potassa in the wine

converts a portion of the iron into a tartrate which remains in solution with tartrate of potassa. An equivalent preparation may be more directly prepared by adding to one pint of Sherry or Rhenish wine one hundred and sixty grains of tartrate of iron and potassa.

FERRI ET AMMONII TARTRAS.—*Tartrate of Iron and Ammonium.*

It is prepared by heating together hydrated sesquioxide of iron and a solution of bitartrate of ammonium. This double salt, when made in small quantities, is in brilliant scales, dark brown in mass, but garnet-red by transmitted light. It has a slightly ferruginous or styptic and sweetish taste, and is very soluble in water.

FERRI CITRAS.—*Citrate of Iron.*

This salt is made by evaporating the officinal solution of the citrate of iron (*Liquor ferri citratis*), which, in its turn, is prepared by the combination of citric acid with the hydrated sesquioxide of iron precipitated from the solution of the tersulphate by means of ammonia. It is in beautiful garnet-red colored plates, slightly soluble in cold, and readily in boiling water, and has an acid, ferruginous taste.

LIQUOR FERRI CITRATIS.—*Solution of Citrate of Iron.*

By adding water of ammonia to a solution of tersulphate of iron, a precipitate is obtained of hydrated sesquioxide of iron, which is then, with the aid of heat, combined with citric acid, forming a solution of the citrate of the sesquioxide of iron. It is a liquid of a deep reddish-brown color, and a slightly chalybeate taste.

FERRI ET QUINIÆ CITRAS.—*Citrate of Iron and Quinia.*

The preparation of this salt is effected by precipitating quinia from its combination with sulphuric acid, by means of an excess of the latter, and the addition of ammonia. The precipitated quinia is then heated in a solution of citrate of iron with which it combines. The resulting double salt is obtained in thin transparent scales of a reddish or yellowish-brown color, with a tint of green. It is readily soluble in hot, but very slowly in cold, water. It is insoluble in ether and officinal alcohol. Its taste is bitter and slightly chalybeate.

FERRI ET AMMONII CITRAS.—*Citrate of Iron and Ammonium.*

This salt is prepared by merely mixing a solution of citrate of iron with water of ammonia, and evaporating and drying the mixture. It is in garnet-red translucent scales, and is more soluble than the acid citrate.

FERRI ET STRYCHNIÆ CITRAS.—*Citrate of Iron and Strychnia.*

This salt is formed by combining citrate of iron and ammonium with strychnia in the proportion of one grain of the latter to one hundred grains of the former.

Mr. Draper, of Dublin, has introduced the following salts, which may be found useful in practice: *Citrate of Quinia, Iron, and Strychnia, and Citrate of Iron and Zinc.* The formulæ for their preparation are given in the *Am. Journ. of Med. Sci.*, April, 1863, p. 466.

FERRI LACTAS.—*Lactate of Iron.*

Gmelin speaks of a chalybeate preparation, *serum lactis chalybeatum*, made by quenching red-hot iron in whey, as combining an attenuating with a tonic powder.[1] More recently Gélis and Conté recommended a lactate of iron prepared, as it now is officinally, by digesting lactic acid upon iron filings. It is also obtained by the mutual reaction of lactate of lime and the sulphate of iron. It crystallizes in plates, or in acicular tetrahedral crystals, which are white when pure, but when impure have a greenish or brownish tint. Its taste is at first sweetish, but afterwards chalybeate and styptic. It is but slightly soluble in water.

FERRI OXALAS.—*Oxalate of Iron.*

Oxalic acid in watery solution, on being added to a solution of sulphate of iron in water, displaces the sulphuric acid and forms an oxalate of iron which is insoluble in water. It is a lemon-yellow, crystalline powder, soluble in muriatic acid.

5. *Compounds of Iron with Halogen Bodies and their Acids.*

FERRI CHLORIDUM.—*Chloride of Iron.*

By the action of muriatic acid upon pieces of iron wire, with the assistance of a gentle heat, the protochloride is formed; and by the addition of nitric acid the protochloride is converted into a sesquichloride or perchloride. It is in deliquescent crystalline masses wholly soluble in water, alcohol, and ether.

A syrup of chloride of iron is made by dissolving half a troyounce of the salt, in a pint of simple syrup.

Bestuscheff's Nervine Tincture, also called *Lamotte's Golden Drops* (*Spiritus sulphurico-æthereus ferruginosus;* Ph. Bor., Austr., etc.), is prepared by mixing one part (by weight) of a watery solution of perchloride of iron, containing ten per cent. of its weight of iron, with one and a half parts strong alcohol, and one half part of ether.[2]

LIQUOR FERRI CHLORIDI.—*Solution of Chloride of Iron.*

A chloride of iron is first formed by the action of muriatic acid upon iron, which by the addition of nitric acid is converted into the sesquichloride, or perchloride, of iron. It is of an orange color, has an acid and strongly styptic taste, and a sp. gr. of 1.355.

TINCTURA FERRI CHLORIDI.—*Tincture of Chloride of Iron; Muriated Tincture of Iron.*

This tincture is prepared by mixing half a pint of solution of chloride of iron with a pint and a half of alcohol. It is transparent, and of a reddish-brown color, but in thin strata is yellowish. It has a very acid and styptic taste. It is chemically incompatible with the alkalies, alkaline earths, and their carbonates, acetate and

[1] Apparat. Méd., pt. ii., i. 333.

[2] For a curious history of this medicine, v. Burin de Buisson, Arch. Gén., Nov. 1860, p. 634.

subacetate of lead, nitrate of silver, mucilage of gum Arabic, tannic acid, and all astringent vegetable preparations.

PILULÆ FERRI IODIDI.—*Pills of Iodide of Iron.*

Iodide of iron being procured by the reaction of iodine upon iron wire and reduced iron in water, the solution, reduced by evaporation, is mixed with powdered sugar, liquorice root, liquorice, and gum Arabic. The mass is then divided into pills, which are coated with a solution of balsam of tolu in ether. Each pill contains about a grain of iodide of iron, and one-fifth of a grain of reduced iron.

SYRUPUS FERRI IODIDI.—*Syrup of Iodide of Iron.*

An iodide of iron is first prepared by mixing together iodine, small pieces of iron wire, and distilled water, and, when the reaction has ceased, the filtered solution is added to a hot solution of syrup. The syrup is of a clear pale green color, and has a strong inky taste.

FERRI FERROCYANIDUM.—*Ferrocyanide of Iron; Pure Prussian Blue.*

"It is obtained by a double reaction ensuing upon mixture of solution of ferrocyanide of potassium, and solution of tersulphate of iron."

Ferrocyanide of iron is familiar as a deep, rich blue pigment; it has neither taste nor smell, and, when pure, is insoluble both in water and alcohol. It is decomposed by nitric and by muriatic acid.

History.—The earliest, and for a long time the only record of the internal use of iron, dates from the sixteenth century before Christ, when, according to Apollodorus, Iphyclus, one of the Argonauts, was cured of impotence by means of iron rust dissolved in wine.[1] In the Hippocratic period, and among the Romans at the commencement of the Christian era, ferruginous preparations were employed topically, and almost exclusively as styptics; yet Pliny speaks of water in which iron had been quenched, having been given in many affections, and particularly in dysentery.[2] The local applications of the rust of iron are thus enumerated by Pliny: it coagulates, dries, and constringes; cures alopecia; with wax and myrtle oil it is used for granulations of the eyelids and pustules of other parts; with vinegar for erysipelas; on compresses for the itch, for paronychia, and for excrescences on the fingers. Applied on wool as a pessary, it controls uterine fluxes; with wine and myrrh is applied to recent wounds, and with vinegar to condylomata. It also allays the pain of gout. Iron scales were employed for similar purposes, and also as a hæmostatic, and Pliny, referring to the last-named quality, says that thus iron cures what iron causes. This writer notices particularly its control over enlargements of the spleen, when topically applied, and Dioscorides alludes

[1] LE CLERC, Hist. de la Méd., p. 21. [2] Hist. Nat., lib. xxxiv. cap. 44.

to its internal use for the same affection.[1] A similar statement is made by Celsus, and also by Aëtius. To the above account nothing material is added by the Arabian writers; but Rhazes says that iron strengthens the sexual powers. He also states that an overdose of iron filings occasions abdominal pain, dryness of the mouth, fever, and severe headache.[2] Yet the use of iron as a medicine does not appear to have been very general until, in the progress of chemistry, various preparations of the metal were applied to the cure of diseases. In the sixteenth century (1571), Monardes of Seville published a treatise on the virtues of iron, in which, for the first time, a just appreciation of its excellence appears. He dwells upon its emmenagogue properties, and on its rendering the barren apt for conception; says that it constringes the stomach, and improves the complexion and appetite, invigorates the liver and other viscera, contracts the spleen, and strengthens the generative faculty.[3] But probably the greatest impulse given to the use of chalybeate medicines was derived from Sydenham (1681), who prescribed them in chlorotic disorders with singular success, and in the manner which will be described in its proper place. In the middle of the last century (1757), Rutty said of chalybeate waters, "They corroborate, cure relaxations, stop fluxes, increase the momentum of the blood, open obstructions, sharpen the appetite, and strengthen digestion."[4] The same author points out all the special contraindications to their use which some writers have conceived to be of recent discovery.

Action on the Animal Economy.—Menghini demonstrated an increase in the proportion of iron in the blood of dogs whose food had had iron mixed with it.[5] So Tiedemann and Gmelin, after giving to a horse six drachms of sulphate of iron, found the metal in the venous blood, but none in the lymph. In their experiments, and in all similar ones, iron is found organically incorporated with the red globules of the blood, and not, like other medicinal substances, freely dissolved in that liquid.

The *bile* in its normal state contains iron, but the proportion is increased by ferruginous substances. This was long ago shown in Dr. Marcet's case of a man who was in the habit of swallowing clasp-knives. After his death the bile in the gall-bladder was found to be perfectly black, and, upon incineration, it yielded more than double the quantity naturally contained in this secretion.[6] After the administration of iron it has been detected in the *milk* of asses and also of women. Bistrow made some very careful experiments to determine the presence and proportion of iron in goats' milk. The analysis of milk from the same animal for six successive days, gave an average of 0.0095 of oxide of iron, before it took any iron with its food; but afterwards lactate of iron was administered in daily doses varying from fifteen to forty-five grains, when it was

[1] Lib. v. cap. 53.
[2] Ebn Baithar, ed. Sontheimer, i. 295.
[3] Alston, Mat. Med., i. 141.
[4] Rutty, on Mineral Waters, p. 249.
[5] Bayle, Biblioth. de Thér., iv. 223.
[6] Med.-Chir. Trans., xii. 62.

found that the average of nine analyses gave as the proportion of oxide of iron 0.0237. Hence the quantity of iron in the animal's milk was more than doubled while it was taking this metal in its food.[1] The *fæces* of persons taking iron, except the preparations insoluble in the stomach and the potassio-tartrate, are generally of a black color, which has been attributed to the formation of a sulphuret of iron in the bowels, and also to the action of the tannic acid contained in the food. The latter opinion is probably the most correct, inasmuch as in children at the breast, and who therefore use no food containing tannin, iron does not give this color to the dejections; besides which, the teeth are stained by iron even when no sulphurous matter is contained in the food, and there are no eructations of sulphuretted gas, provided that the astringent principle referred to is present.

The quantity of iron secreted with the *urine* is extremely small, and its appearance in this liquid at all depends somewhat, at least, upon its mode of combination when taken. Among martial preparations, the one which reveals its presence most distinctly in the urine is iodide of iron; and in this case the metal is probably carried along with the iodine, the tendency of which to be excreted with the urine is very remarkable. That, however, iron is sometimes excreted by the kidneys when it is abundantly used, and especially when it is taken in natural mineral waters, is shown by the inky precipitate the urine gives in these cases on the addition of tincture of galls. Iron, too, has been found as a constituent of some varieties of calculous deposits. Besides these demonstrations, it may be remarked that iron occasionally gives rise to a good deal of vesical irritation, and also, as we have already seen, that the ancients regarded it as an aphrodisiac. The existence of this quality, indeed, does not admit of doubt; but whether it arises from a direct irritation of the genito-urinary apparatus by the medicine, or indirectly from a general improvement in the tone and vigor of the functions induced by iron, is still an open question. Both modes of action are probably real, but the latter is the one most frequently observed.

Among the preparations of iron there are three which may occasion poisonous effects. They are the iodide, the chlorides, and the sulphates. In their irritant operation, however, it is not their metallic element which is active; it is the iodine, the chlorine, or the sulphuric acid which is the chief cause of the toxical phenomena. Thus, iodide of iron, given to animals in excessive doses, occasions vomiting, purging, gastric inflammation, and death; and the remaining compounds produce inflammation and ulceration of the coats of the stomach. Even in man two of these compounds have had fatal effects. The muriated tincture occasioned death in one case reported by Christison, and a notice of several other cases, in which life was greatly endangered, is contained in Mr. Taylor's work on poisons. In one of these great irritation of the whole

[1] VIRCHOW's Arch., xlv. 98.

urinary system followed, but was speedily removed; in another the mucous membrane of the mouth and œsophagus became hot and dry, and vomiting of blood took place. A woman, thirty years old, swallowed an ounce of "Tr. ferri perchloridi, B. P." In fifteen minutes she was seized with violent convulsions, her face was flushed, the pulse small and frequent. On the failure of several emetics to produce vomiting, this act was induced by tickling the fauces, an acid yellowish fluid was rejected, followed by relief and recovery in three or four hours. Half an hour after the vomiting she had an attack of diarrhœa, with black stools, which soon ceased.[1] The sulphate of iron has been taken in the dose of an ounce without causing death; but in other cases death, preceded by vomiting and purging, has occurred. Two such instances may be found in Dr. Taylor's work, and three are recorded by Orfila in which the preparation was administered with criminal intent. Experiments upon animals, by Dr. James Blake, show that the quantity of the different salts of iron required, when introduced into the blood, to produce death, is extremely different, for whilst sixty to seventy grains of the protosalt can be circulated in the blood without producing any fatal symptoms, four or five grains of the persalt will destroy life.[2] These results are in accord with the statement at the beginning of this paragraph.

Sulphate of iron, in solution, has produced serious effects by its external application. Pyl relates a case in which the head of a child affected with tinea was washed with a solution of this salt. Severe burning pain of the scalp was followed by thirst, vomiting, and fatal convulsions.[3]

Of *ferrocyanide* of iron Lewis long ago remarked that, as it is not soluble in ordinary liquids (water, diluted acids, alcohol, ether, oil), it is the least promising of all the medicinal preparations of iron. Although, when pure, it produces no sensible derangement of function, yet Dr. Jackson saw distressing cerebral and nervous symptoms, obtuseness of the senses, and restlessness; and Dr. Fahnestock delirium, coma, and even death, produced by the preparations which they employed.[4] Unquestionably these preparations were impure. The experiments of Coullon upon animals show it to be inert even in large doses; indeed, it appears to be unchanged in its passage through the system. If it has seemed to display active properties in the treatment of disease, it is probably because the preparation was impure by containing an excess of hydrocyanic acid or of the protoxide of iron.

The soluble preparations of iron are apt to produce a discoloration of the teeth, which is an effect of the union of the metal with the tannin contained in the food. It is easily removed by means of a stiff brush with charcoal dentifrice, especially if the latter contain tannic acid. The iodide of iron sometimes produces a blue

[1] Lancet, Jan. 1869, p. 9.
[2] Am. Journ. of Med. Sci., Jan. 1869, p. 235.
[3] Wibmer, Wirkung, etc., ii. 360. [4] Am. Journ. of the Med. Sci., iii. 244.

color of the same parts, which may be removed by a solution of carbonate of soda. Dr. Smith, a surgeon-dentist of Edinburgh, immersed teeth in various solutions of ferruginous compounds, and found that they were acted upon very powerfully by the muriated tincture, the sulphate, and the wine. In the first mentioned the fangs became quite soft and flexible, and the enamel was wasted away; in the second the enamel and dentine were superficially softened; and in the third the action was scarcely appreciable.[1]

Theory of Action.—Cullen taught that the medicinal virtues of iron entirely depend upon its astringent and tonic powers, and he treats slightingly the experiments of Menghini "concerning the iron constantly in the blood of animals, or the manner in which it is introduced into it."[2] Wolff, Menghini, and others, had already shown that iron is absorbed from the stomach and bowels; and they taught that it entered the vessels and quickened the languid circulation of the blood in leucophlegmatic and chlorotic persons.[3] This statement is in conformity with the opinions of Willis and Sydenham, and of Haller, who maintained, a century ago, that iron imparts its color to the blood. It was thus early recognized that iron is, like cod-liver oil, a nutrient rather than a medicine, since it furnishes one of the most important elements of the organism, and the one which is always deficient in the diseases for which it forms the most effectual, and, as it were, specific remedy.

The most evident effect of iron is that during its administration the blood becomes redder, and its red disks more abundant. The anæmic girl, or the woman drained of her blood by uterine hemorrhage, so that the liquid in her veins is scanty and almost colorless, has the florid hue restored to her cheeks and the fulness to her veins by means of iron, as certainly as the tertian ague is cured by quinia. That these effects do not proceed from a merely tonic power in the medicine, is proved by the fact that no other tonic, mineral or vegetable, not even cinchona itself, produces such a change. On the other hand, it is certain that whenever the activity of the circulation is accompanied with fever, and especially when the blood presents a buffy coat, the administration of iron is injurious.

The red blood-disks appear to be *the organ* to which iron is especially directed, and by which the activity of animal as well as of organic life is sustained at the highest point. These bodies it is which, by contact with the inspired air in the lungs, attract and become impregnated by oxygen, the essential agent in all the compositions and decompositions which sustain life in the tissues, acquiring thereby the scarlet hue of arterial blood which they lose with their oxygen in their passage through the tissues to the venous system. Thus it would appear that the activity of nutrition, and probably also of calorification, is dependent upon the iron in the blood, and that when the red blood-disks which contain it

[1] Edinb. Med. Journ., xi. 631.
[2] Mat. Med., ii. 22.
[3] Gmelin, App. Med., part ii., i. 310.

are most abundant, all of the functions of the economy attain their highest degree of activity and vigor, such as is displayed in persons of a sanguine temperament.[1] The influence of iron upon calorification is no longer a matter of conjecture, it has been fully demonstrated by the numerous and accurate experiments of Pokrowsky,[2] who proved that not only does it raise the temperature of the body when it is lowered by disease, but that when under a given dose the temperature ceases to rise, it will attain a still higher degree if the dose is increased. The pulse becomes fuller, and the weight of the body and the proportion of urea excreted are simultaneously augmented. All the preparations of iron used for internal administration have the same effect. Botkin has also proved that iron, even in healthy persons, raises the temperature above the normal standard.

In the opposite conditions of the economy, the proportion of blood-disks is less than normal, and all experience testifies that it can be restored by no means so readily as by iron. This fact was known long before the blood was ascertained to contain iron, or any definite notion of its operation was entertained. The indications universally recognized for its use were persistent pallor and softness of the tissues with general debility.

It is altogether improbable that iron is merely associated mechanically with the blood-disks. These bodies are living organs, one of whose constituents is iron. It is derived from the animal and vegetable substances which serve as food, and in which it is, for the most part, as vitally combined and as intimately as it is in the human organs themselves. In health the appropriation of this essential element is readily performed, but not so in disease. Hence, if the system is, of its own strength, unable to assimilate the iron contained in food which is imperfectly digested, an artificial supply of the element becomes necessary for the restoration of health.

The doctrine that iron is a constituent of the blood-disks, and exists in them in definite proportions (forming six per cent. of their hæmatin), appears to be supported by the fact, repeatedly observed, that when this mineral is used by persons who are already in good health, it does not produce nor increase plethora so long as the animal functions are maintained in active exercise. Brandis states that this is of common observation at chalybeate springs, the waters of which are habitually drunk by man and beast without the slightest injury. Brück, also, in his experiments upon rabbits, found that for a time a large proportion, or the whole even, of the iron given them was assimilated, but that a point of saturation was subsequently reached, and the iron administered to the animals was evacuated with a trifling loss. Even when in man the administration of iron is unduly prolonged, and produces a plethoric condition of the system, it must be remembered that this plethora is not posi-

[1] Brandis, Erfahrungen über die Wirkung der Eisenmittel. Hannover, 1803. Compare Casselberry on "Use of Iron," Am. Journ. of Med. Sci., April, 1858, p. 327.

[2] Virchow's Arch., xxii. 476.

tively, but only relatively, a morbid state, or, indeed, is less a state of disease at all, than one in which disease is imminent, but can be averted by a physiological regimen which shall quicken the organic nutritive changes.

But such a regimen is not always possible when the use of iron is clearly indicated by evidences of anæmia; and then the medicine will continue to be useful until the point of saturation of the blood is reached. On the other hand, it will from the beginning prove injurious, if the blood already contains its due proportion of this metal. It is, we apprehend, a very common error to confound nervous debility and excitability with impoverishment of the blood in regard to this particular element. Undoubtedly, as we have before insisted, the blood is a regulator of the nervous system; but it is not the only one. The constitution of the blood remaining unchanged, the nervous system may be exhausted by agencies which operate directly upon it, and upon it alone. Nervous shock, mental emotion, excessive pain, overstrained pleasure even, may exhaust, prostrate, or even suddenly kill, and in the whirl and strife of city life nothing is more usual than to meet with patients of both sexes who are perishing from exhaustion of nervous power, and whose blood, if it be changed at all, becomes so, not as an immediate consequence of the derangement of the assimilative functions, but remotely as an effect of nervous strain, exhaustion, and disorder. It is not always easy, indeed it is often very difficult, to determine in a given case whether the primary link in the chain of morbid phenomena is attached to the blood or to the nervous system, since each suffers by the prolonged disorder of the other; but it is of the utmost consequence in relation to the treatment that this question should be correctly solved. If the nervous functions are primarily deranged and the blood has not become impaired, the effect of iron will be to aggravate the symptoms, to blunt the appetite, impair digestion, constipate the bowels, coat the tongue, and render the urine denser and more irritating; it will occasion fulness and pain of the head, imperfect vision, noises in the ears, and mental as well as physical lethargy. These are some of the effects, which one may daily witness, of the use of iron when the system does not need its reparative influence on the blood, but rather the operation of nervous stimulants, such as quinia and strychnia, and, above all, hygienic measures, to which all others must, in the nature of things, be subordinate.

A theory of the operation of iron, proposed in conformity with the phenomena observed during the use of ferruginous preparations, and which appears to possess a strong degree of probability, is the following: Iron, on entering the bloodvessels, combines immediately with the disks which have not yet acquired, or which have lost more or less of their ferruginous element. It enters the blood as a chloride, is decomposed, combines with the disks as a carbonate of the protoxide of iron, and in the lungs gives up carbonic acid and absorbs oxygen, and is thereby converted into a peroxide. The white corpuscles are destitute of iron, but when

once saturated with it neither they nor the red corpuscles can receive any more.[1] It is this theory, we repeat, which explains the facts pointed out by Brandis, Giacomini, Brück, and many others, that iron ceases to influence the economy when it has once restored it to a healthy condition. It has been remarked of that portion of the theory which regards the iron as a protoxide on entering the blood, and as becoming peroxidized in the lungs, thus making the red blood-disks the carriers of oxygen to the tissues, that we have as much reason for supposing that the iron is absorbed originally as a peroxide, and that it parts with an equivalent of its oxygen in the tissues, but regains it while traversing the lungs. Still, this view does not impair the theory first propounded by Liebig, that the red globules carry oxygen from the lungs to the tissues, and carbonic acid from the tissues to the lungs, in performing which service it wears by turns the scarlet hue of arterial and the crimson color of venous blood. Other investigators appear to regard iron as acting directly, and independently of its combination with the red corpuscles, as a carrier of oxygen, or rather of ozone derived from atmospheric oxygen.[2]

Certainly, one of the most curious examples of the power of a theory to warp even an acute and ingenious mind is presented by Giacomini's assertion that iron, far from being a tonic, is a sedative. He affirms that fifteen grains, or, at most, three times that quantity of carbonate of iron, render the pulse slow and feeble, and the skin pale, and occasion chilliness, general debility, and trembling of the limbs. In order to meet the palpable objection to this notion, viz., that iron raises the tone of all the functions, he affirms, not only that it has no such effect upon men in a healthy state (which, however, is not the question), but that in diseases in which it is advantageous, it only *appears* to have this effect; that then, in reality, the "vital powers are not deficient, but, on the contrary, are accumulated in excess, and, so to speak, are smothered and weighed down by the violence of the disease, and that they only need to be diminished in order to bring them into equilibrium with the state of the system."[3] It is evident that these are mere phrases with which the author of them deceived himself, and misled those who are disinclined to look narrowly into a medical theory which an eloquent advocate or a sophistical reasoner has persuaded them to adopt.

Undoubtedly iron is, according to its combination, tonic (reconstituent), or astringent. The latter quality is most conspicuous when it is united with a mineral acid or with chlorine; the former when it is given in the negative metallic state and combines with the acid of the stomach, or is administered in combination with organic acids. In general it is contraindicated by vascular excitement, plethora, congestion, and inflammation. It must be given

[1] Selade, Canstatt's Jahresbericht, 1846, p. 234.
[2] Br. and For. Med.-Chir. Rev., Jan. 1866, p. 233.
[3] Mat. Méd.; Trad. Fran., p. 372.

with great circumspection to thin persons of a dry and irritable constitution, in dyspepsia with bilious derangement, in phthisis in the stage of softening, and in chronic bronchitis with purulent expectoration and hectic fever.

The Preparations of Iron Compared.—If an insoluble preparation of iron is introduced into the stomach, and is susceptible of being acted upon by the gastric juice, it unites with the latter more or less; and if a soluble compound is so introduced it is more or less precipitated, the gastric acids uniting with its base. Thus it is evident that the quantity of iron absorbed from the stomach depends upon the quantity of the metal which is taken and which remains soluble or is rendered so by the gastric juice. Those preparations which are with difficulty attacked by this liquid, and remain undissolved, should therefore be the least adapted for medicinal use. But, although theoretically the insoluble preparations may appear to be least fitted for this use, they are, nevertheless, among the most certain in their effects, provided that the acid secretion of the stomach is sufficiently abundant to saturate them. In order to secure this object, the doses of iron should be small and frequently repeated, especially if taken when the stomach is empty; but when this organ contains food and the supply of gastric juice is abundant, the dose may be augmented. Other things being equal, it is probable that preparations of the protoxide are more efficient than those of the peroxide, because in the same bulk they contain a larger proportion of iron.[1] It should not be forgotten that whatever portion of an insoluble preparation of iron is not appropriated by the gastric acids must enter the intestine unchanged, and that it sometimes occasions there annoying irritation. It may even in the case of precipitated carbonate of iron accumulate and form large concretions in the bowels. Examples of this occurrence were formerly not infrequent. If the soluble salts of iron are decomposed in the stomach, as appears to be probable, they possess no special advantage over the insoluble preparations. There is one among them, however, which, if it forms an exception to the rule, as it is believed to do, must offer advantages that will presently be pointed out.

Modern chemical science has carefully investigated the changes which the several preparations of iron undergo in the economy, and the conclusions arrived at by Quevenne, Bouchardat, Mialhe, Mitscherlich, and others, appear to be confirmed equally by physiological considerations and by experience. Without being in all cases identical, they are sufficiently analogous to serve as a key, if not always as a guide to practice.

It appears, as already stated, that the soluble salts of iron are more or less precipitated by the gastric liquids, including mucus

[1] Every fifty grains of the following preparations contain the proportion of metallic iron set after their respective names: Iron reduced by hydrogen, 50 grs.; black oxide, 36 grs.; protocarbonate, 25 grs.; protochloride, 21 grs.; persulphate, 14 grs.; tartrate of iron and potassa, 11 grs.; protosulphate, 10 grs.; lactate, 10 grs.—SOUBEIRAN, *Bull. de Thérap.*, xlviii. 307.

and the organic principles of the food, which form with the precipitate an insoluble compound. Mialhe holds that even the insoluble preparations are at first rendered soluble by the gastric juice, and then precipitated by an excess of the same liquor, to be redissolved on reaching the duodenum by the bile, pancreatic juice, and other alkaline secretions of this portion of the intestinal canal. He also maintains that the potassio-tartrate of iron forms an exception to this rule, and that having been absorbed without undergoing any material change or loss, it is transformed into a carbonate of iron in the blood. Each of the preparations of iron which are capable of modifying the composition of this liquid, is supposed to enter it in some combination, which, whether original, or resulting from reactions that occur in the primæ viæ, is decomposed by the free or carbonated alkalies of the blood, so that iron probably arrives at its ultimate destination in the globules as an oxide (peroxide).

If these views are admitted, it follows that unless a chalybeate preparation which is soluble in the gastric juices be also susceptible of precipitation from solution in them by the free alkalies or their carbonates, it cannot modify the composition of the blood. This is the case with the cyanide and the sulpho-cyanide of potassium and iron, which are consequently discharged with the urine, while other compounds of iron appear but slightly in this secretion.

It may now be found instructive to inquire what are the peculiarities which distinguish the action of the chief ferruginous preparations from one another. *Metallic* iron in its proper medicinal forms is readily acted upon by the gastric liquids and the more so when it is minutely divided, as in the case of iron reduced by hydrogen. An objection to iron fillings has long existed, which is that they occasion offensive eructations of sulphuretted hydrogen, which are presumed to arise from a combination of the sulphur usually contained in iron with hydrogen, evolved during the oxidation of the iron by the gastric liquids. When iron is very pure, as in the case of Quevenne's preparation, this effect is not observed, or is so in a slight degree only. The *oxides* and *carbonates* of iron are more bulky preparations, and although less generally used at present than formerly, are, nevertheless, efficient chalybeates. As the protoxides, by exposure to the air absorb oxygen and thus become less soluble in the gastric liquids, the preparation in which the oxidation is prevented, to some extent, by honey (*Pilulæ Ferri Carbonatis*), has taken the place of the others in practice, and is with Quevenne's iron the most efficient of all the insoluble preparations.

Of the compounds of iron with mineral acids the *sulphate* has too much astringency to be used as re-constituent of the blood, unless in a very largely diluted solution. In that condition it exists in some of the most celebrated chalybeate waters. It must be speedily decomposed in the stomach. The same remarks are applicable to the *nitrate* of iron, but in a less degree. The *persulphate* is used exclusively as an external application. The *phosphate* stands in an intermediate position between the mineral and the organic com-

pounds of the metal, relatively to its energy, it being less astringent than the former and less gentle in its operation than the latter. The *pyrophosphate* possesses the same qualities, and, as it has no ferruginous taste, is well adapted to cases in which the stomach is delicate. It is not an eligible preparation when a tendency to diarrhœa exists. It contains 21.11 per cent. of iron.

Among the compounds of iron with organic acids, the *tartrate of iron and potassa* is one of the most valuable. As Mialhe and Quevenne have remarked, it is at once the richest in iron, the most agreeable to the taste, the least irritating to the bowels and oppressive to the stomach, the least apt to occasion constipation, and the most readily absorbed of all the soluble furruginous preparations. According to Mialhe other soluble compounds of iron are precipitated in the stomach, and so much of them only can be absorbed as is re-dissolved by an excess of acid. He claims to have shown, that although this salt, like others of its class, is precipitated in the stomach, "yet, on reaching the intestine and there coming in contact with the alkaline secretions it is not decomposed; and, as the acid which occasioned its precipitation in the stomach unites with the alkaline bases, the iron resumes the solubility which it had temporarily lost, and becomes apt for absorption throughout the whole intestinal tube, so that it can be administered as effectually by the rectum as by the mouth."[1] If this view of its operation be correct, the medicine must possess the singular advantage of not being dependent, like the other most useful preparations, upon the gastric acids for absorption. Indeed, they interfere with rather than promote this process, and as Quevenne has observed, the most favorable time for administering the tartrate ought to be between meals, when the stomach contains no acid.

The *lactate* is regarded by some authorities as preferable to other salts of iron, because its acid is presumed to be the same that normally combines with this metal in the stomach. But there is no sufficient ground for adopting this opinion as the basis of a practical method. If the results of the experiments performed with this salt by M. Boudet were accepted, they would overturn several of the conclusions respecting the digestibility of iron salts which are founded alike on experiment and experience. The *citrate* of iron is even more tasteless than the tartrate of iron and potassa, and is an excellent preparation when the stomach is delicate. The *citrate of iron and quinia* has no demonstrable advantage, except convenience of dispensing, over an extemporaneous union of these medicines; the same remark may be made of the *citrate of iron and strychnia;* and the *citrate of iron and ammonia*, although it is a compound of the same nature as the tartrate above described, is inferior to the latter for all the purposes to which chalybeate medicines are applied. The *tincture of chloride of iron* is of all ferruginous compounds, except the perchloride (solution of chloride of iron), and the persulphate, the one that exerts the most powerful

[1] Chimie Appliquée, p. 326.

local action as a styptic, and indeed as a caustic upon delicate tissues. Hence, even when given largely diluted, it probably coagulates the mucus and constringes the lining membrane of the stomach. A diuretic operation is attributed to the medicine, which is due either to its acid constituent, or, according to Headland, to "a peculiar ether formed with the spirit by an excess of hydrochloric acid used in the preparation of the tincture." The *solution of chloride of iron* is more astringent than the last preparation. Its syrup, as generally made, consists of half a troyounce of perchloride of iron, dissolved in a pint of simple syrup, and flavored to the taste. It may be given in doses of a teaspoonful when the stomach is empty, in all appropriate cases of internal hemorrhage, and in relaxed conditions of the stomach and bowels. A pharmacien of Paris, M. Adrian, assures us that it is incompatible with albumen, gum, mucilage, tannin, ergotin, opium, and in general nearly all organic substances, including cane sugar, which it transforms into grape sugar, and is itself converted into the protochloride,[1] and that consequently the officinal syrup soon ceases to possess its original qualities. The *subsulphate* of iron surpasses the preparations just referred to in astringency, and is, in fact, the most powerful hæmostatic known. The tincture of Bestuscheff is believed to possess qualities which adapt it to occasional use in cases of slight anæmia with great nervous susceptibility.

The *iodide* of iron, according to Cl. Bernard and M. Gille,[2] is the only known ferruginous preparation of iron which can be detected in the saliva and milk, as well as in the urine, and on that ground a peculiar efficiency is claimed for it. On the other hand, Mialhe and Quevenne, and also Trousseau, who adopts their conclusions, believe that the iodide is no sooner introduced into the economy than it is decomposed, "the iron being retained and the iodine rejected." These writers go so far as to recommend, as being preferable to the iodide of iron, the simultaneous use of some other preparation of iron and of the iodide of potassium. It appears, then, that respectable authorities are at issue in regard to a point of fact. Therapeutists, meanwhile, who have observed the effects of the compound in question, are quite agreed that they are such as partake of the effects of iodine as well as of iron, and consequently that, if the iodine of the compound is rejected, it is not so in such a degree as to interfere with its special therapeutic operation.

Prussian blue, the *ferrocyanide* of iron, when pure, is probably but little acted upon by the gastric juices. The alkaline secretions of the small intestine are said to produce no other effect upon this substance than to convert it partially into the yellow hydrocyanate of potassa and iron, which is likewise inert. The Prussian blue of commerce, however, contains, according to Mialhe, a certain portion of oxide of iron, which is, of course, susceptible of solution in the gastric acids.

[1] Bull. de Thérap., lxv. 262. [2] Monographie de l'Iodure de Fer, p. 42.

Remedial Employment. *Anæmia and Chlorosis.*—There is a class of diseases which have sometimes been grouped together, and under various names, in all of which there is a deficiency of the proportion of red disks in the blood, and in some of them another morbid element in addition. The principal affections of this class are, anæmia (the idiopathic form is here mainly intended), chlorosis, hypochondria, the state of convalescence from exhausting diseases, the cachexia produced by marsh miasmata, some forms of dyspepsia, and some also of general dropsy depending on renal disease.

The symptoms common to these disorders are very conspicuous in anæmic chlorosis. The most important of them are the following: a dingy or greenish pallor of the skin, colorless and shrivelled lips, with pale, soft, and, in protracted cases, a shrunken condition of the gums. The skin has lost its elasticity; the cellular tissue is often œdematous, especially under the eyes and around the ankles; the hands and feet are habitually cold, the muscular strength is impaired, and slight exertions occasion great fatigue; the peristaltic action of the bowels is diminished, owing partly to the diminished secretion of the liver, and in part, also, to debility of the muscular coat. During the digestive process the coldness of the hands and feet increases, and is often accompanied with gastric uneasiness, a sense of general discomfort, and palpitation of the heart. If a person presenting these symptoms loses blood, they are all greatly aggravated, fatal syncope is threatened, and the blood itself is pale and watery. The pulse is usually small and quick, and is rendered unnaturally frequent by exercise, mental excitement, or laborious digestion. Sometimes, indeed, distinct and regular febrile paroxysms occur, and this circumstance it is which gave to chlorosis the expressive name of *febris alba.*

Even more striking than these are the phenomena which the nervous system presents. *Sanguis moderator nervorum* is an old and true aphorism. When the constitution of the blood is impaired and deteriorated by a partial loss of the red disks, the energy of nervous movements and their co-ordination are alike impaired, and the system falls into irregular action. It displays an unnatural sensibility to external impressions, especially a want of tone which places it at the mercy of every transient influence, and leads the mind to form exaggerated estimates of pleasurable as well as painful sensations. Muscular quivering and spasms, fits of fainting, obstinate vomiting, causeless bursts of laughter or floods of tears, these are the common phenomena of anæmic hysteria. They are not the effect of weakness merely, for in exhausting diseases of the lungs or bowels no such effects occur; on the contrary, the victims of phthisis are, above all, remarkable for the hopefulness and calm which attend their gradual decline. Although these symptoms are common in chlorosis, they are by no means so frequent in simple anæmia, in which the patient gradually wastes and withers without any evident cause, and in which, also, the nervous susceptibility has more of a physical and less of a mental character.

The shortness of breath on muscular exertion, which is common to all forms of anæmia, results directly from a diminution in the mass of the blood, and especially in its proportion of red disks. It seems to be explicable by the diminished power which the blood then has of receiving or attracting the oxygen of the air, and, in this way, of imparting vigor to all of the functions. Evidently every muscular exertion must increase the demand for oxygen in the lungs, and consequently quicken the circulation and the respiratory movements; when, therefore, as in anæmia, the blood is impoverished, and the nervous system is feeble as well as morbidly excitable, the strenuous exertions made to accomplish the oxygenation of the blood soon exhaust the strength and occasion hurried and panting respiration, and may even paralyze the heart and induce fatal syncope.

Digestion cannot be normal when the blood has ceased to be so. The appetite fails, or is irregular, or there is a craving for unwholesome food, or whatever is taken seems not to nourish the body, no matter in what quantity it may be consumed. The abdomen is usually distended, and the bowels are obstinately constipated.

In the chlorotic female a symptom is usually present which, even more than the external aspect, seems to characterize the disease—a *scanty*, *irregular*, or, with both of these conditions, *painful menstruation*. The menstrual disorder is often regarded as the starting-point of the symptoms of chlorosis; but however this may seem to be in some cases of the disease following a sudden suppression of the catamenia, it is not the less certain that chlorosis is much more frequently a cause than an effect of imperfect menstruation. Indeed, the disease is sometimes met with, complete in every possible particular, in persons of the male sex.[1] It is of the highest importance not to lose sight of this fact when we attempt to cure chlorosis by means of remedies addressed to the general system, and mainly to the blood; and it leads us, with Sydenham, to regard as quite secondary the use of remedies which have a special influence upon the reproductive organs of the female. This eminent physician was the first who gave the true indications for the use of iron as a reconstituent of the blood in chlorosis, and in the cachexia produced by malarial poison. In his day these affections, as indeed all others, were treated mainly by evacuants and nervine stimulants, the former of which tended to perpetuate the condition which the latter could at best but palliate. While he distinctly laid down the proposition that "the chief curative indication is the restoration of the blood," he was to that degree swayed by the doctrines of his age that he used evacuants whenever they could be borne, even while he acknowledged that they often rendered the condition of the patient worse. But, having paid this reluctant tribute to an established doctrine, and having dismissed it with the sarcasm that if some recover after using evacuants as well as chalybeates, "such cases say more for the virtue of the iron than for the

[1] Uzac, De la Chlorose chez l'Homme, Paris, 1853.

skill of the doctor," he advises that the medicine should be administered for thirty successive days. "It is sure," he says, "to do good. To the worn-out and languid blood it gives a spur or fillip, whereby the animal spirits, which before lay prostrate and sunken under their own weight, are raised or excited. . . . The pulse gains strength and frequency, the surface warmth, and the face (no longer pale and deathlike) a fresh, ruddy color."

But while this is true in its application to those cases of anæmia which are of recent occurrence, and in which, therefore, the altered constitution of the blood has not occasioned any radical change in the nutritive function, the case is different when the morbid habit has become fixed, and every organ and every function has departed from its healthful state and action. Although the restoration of the normal composition of the blood is the first and the essential step in the treatment, other means will be necessary to remove the results of a deranged nutrition. Indeed, it is often only by invigorating the system by means of various stimulants that iron can be digested, and applied to its proper purpose. It cannot be too often repeated that in anæmia iron is food, and is medicinal only in so far as it is assimilated, which it will not be unless the system is stimulated by exercise, fresh air, bathing, change of scene, etc. In some cases, it has been remarked by Trousseau, iron, after having for a time diminished the symptoms of chlorosis, suddenly becomes inoperative, or is no longer tolerated. This singular fact appears to admit of explanation. The blood having received all of the iron it is physically capable of receiving in its impaired condition, the improvement of the health is suspended; but, if by other medicinal and by hygienic means the appropriative power of the system is increased, the iron begins anew to be assimilated. In regard to almost every article of food, and especially in regard to those which have the strongest flavor, it is proverbially true that a continued and exclusive use of them breeds disgust.

There is a gastric debility which sometimes renders the digestion of iron and of all nutriment extremely imperfect, until the administration of acid, alcoholic, or bitter stimulants enables the stomach to perfect the conversion of medicinal iron into a constituent of the living body. Or there may be an irritability of the bowels with a constant tendency to diarrhœa, which must be checked by appropriate remedies before the administration of iron can become useful or even safe; or, finally, there may be a liability to be unpleasantly affected by some preparations of the metal, when a patient trial of other forms or combinations may be crowned with complete success. To look upon iron as a specific medicine which must necessarily cure anæmia under whatever form or with whatever complications it may occur, is to lose sight of the plainest teachings of experience in regard to the curative operation of all remedies whatever. It is by a skilful discrimination of the peculiarities of individual cases, and a judicious adaptation to them of remedial measures, that the true physician is pre-eminently distinguished from the routine practitioner. He will as little discard iron from among the

medicines to be used in anæmia and chlorosis, as he will rely upon it exclusively in the treatment of those affections. He will remember that because iron is food, it will, like all other food, do good or evil according to the fitness of the patient to assimilate it, and according to the need which the system has of that element of nutrition.

In the remarks that have been made upon the use of iron in anæmia and chlorosis, reference has been had to that class of cases only in which the altération of the blood is independent of any cachexia depending upon a specific poison, as that of syphilis or lead, as well as of any organic vice such as displays itself in cancerous or in tuberculous disease. For the two former there are specific remedies of which iron is not one; for cancer the art of medicine has no method of cure; and, as regards scrofula, tubercle, and the pneumonic forms of phthisis, it may be remarked that chalybeate preparations are two-edged weapons, which, unless they are employed with extreme circumspection, often endanger the patient more than they restrain the disease.

In regard to the choice of preparations, it is possible that every one of them may have its peculiar and exclusive advantages, yet the universal agreement of those physicians who are most competent to judge in the matter has determined the question differently. Upon this point Sydenham suggests a criticism, which would not be altogether misplaced at the present day. Steel, he says, "is best given in substance; in which form I have neither seen nor heard of its doing mischief. Nay, the simple substance effects a cure both more surely and more quickly than any of the current preparations. With steel, as with other more famous medicines, the officious sedulity of the chemists has not only failed in adding to its activity, but has succeeded in diminishing it."[1] Next to steel Sydenham preferred a syrup made from Rhenish wine in which iron or steel filings had been steeped. This was really a syrup of the tartrate of iron and potassa, a preparation, which, as elsewhere stated, we regard as worthy of the first place among ferruginous medicines, on account of the facility of its administration, its acceptableness to the stomach, and its probably conveying into the blood a larger portion of iron than other preparations of its class. It should generally be given when the stomach is empty.[2] The less soluble forms of the medicine, particularly metallic iron, either procured by filing or in the purer state of iron reduced by hydrogen, and the so-called carbonates, including Vallet's ferruginous mass, are all very efficient preparations, and in spite of theoretical preferences for one or another of them, are of nearly equal efficacy when given in the same proportionate dose. They should seldom be taken on an empty stomach, especially the more bulky of them,

[1] Works, Syd. Soc. ed., ii. 98.

[2] Dr. Tully, strangely enough, pronounced "the supposed tonic effects" of this salt "a delusion," and maintained that the antiphlogistic action of the tartrate of potassa "must more than countervail the feeble tonic power" of the small quantity of iron with which it is associated.—*Mat. Med.*, p. 1101.

for they then are apt to cause oppression and heartburn; but should be given immediately after a meal, so as to insure their solution in the gastric liquids.

Several combinations of iron have enjoyed a peculiar vogue in the treatment of chlorosis. Among these are Blaud's pills, which are made of sulphate of iron and carbonate of potassa, between which, doubtless, a double decomposition is partially effected. They enjoyed and still enjoy a great repute in France, where their efficacy has been attributed in part to their alkaline ingredient. They are, however, given in very large doses. Griffith's mixture (*Mistura Ferri Composita*), made of the same active materials, with the addition of myrrh, has been widely esteemed for its efficacy in anæmia and amenorrhœa; we have found it especially advantageous when certain chronic skin diseases (psoriasis, eczema) are maintained by debility, as they often are in old persons. Bestuscheff's tincture, into which Hoffmann's anodyne enters, is an agreeable form for administering a nervine with iron when hysterical or nervous symptoms attend chlorosis.

Menstrual Derangements.—Of these there are several forms in which iron displays specific virtues, because they all ultimately depend upon the deficiency of red globules in the blood; but they are modified by a special condition of the patient. In that simple variety of uterine disorder in which at monthly periods or oftener, the female loses a large quantity of imperfectly coagulating blood, which, with each returning menstrual epoch, grows more watery, while the general symptoms become more and more those of anæmia, iron alone will usually be found sufficient for a cure. The normal state of the blood having been once restored, the menstrual hemorrhage and the anæmia terminate. There are cases, on the other hand, of simple anæmia in which the menstrual discharge is merely scanty or suppressed, accompanied in the former case with some degree of uterine pain, and in the latter replaced by an ineffectual and painful effort recurring, with more or less regularity, at monthly periods. Such cases are usually cited as indicating torpor of the uterine system; and it is certain that in their treatment an almost essential adjunct to iron consists in the use of aloetic laxatives and other uterine stimulants, and such general hygienic measures as tend to excite and strengthen all the functions of the economy. Again, menstrual derangement may be attended with symptoms in which nervous disorders play the principal part, but not disorder of the hysterical kind. The uterine loss is trifling, but it is effected with throes of pain which are only less intense than those of childbirth, while the hands and feet are very cold, and the head hot; a fibrinous cast of the uterine cavity is thrown off, and the catamenial period is preceded and followed by a leucorrhœal discharge. Under these circumstances the mere administration of iron would be more mischievous than useful, because there is a local derangement, a chronic congestion probably, associated with, and partly, indeed, dependent for its continuance upon the impoverished state of the blood. This local condition must

first be moderated by cupping and counter-irritation of the sacrum, by leeches to the cervix uteri, by laxative medicines, by local stimulants and mechanical remedies, and by suitable exercise, before ferruginous medicines will restore the natural flow.

Hemorrhage.—Iron is totally inadmissible, except as a direct hæmostatic, in all cases of active hemorrhage; its usefulness is proportioned, on the other hand, to the passive character of the loss of blood. Whenever this depends upon an impaired constitution of the circulating fluid consisting in a deficient proportion of the blood-disks, iron is the specific remedy; but in scorbutic affections in which the fibrinous element or the vital condition of the blood is impaired, the value of iron is subordinate to that of the vegetable acids. Uterine hemorrhage of a passive form is that in which the medicine is most effectual. It is contra-indicated whenever the disorder is dependent upon plethora. In appropriate cases, also, iron forms the best prophylactic, by rendering the blood too dense for passive exudation, and in these the preparations are most appropriate which are mildest in their local operation, and are longest retained in the system. To produce a directly hæmostatic effect, the muriated tincture and the perchloride of iron (*Liquor ferri chloridi*) are by far the most efficient preparations; and next to these the solution of the subsulphate. Thus is purpura hæmorrhagica,[1] in passive hemorrhages from the stomach, bowels, uterus, or urinary passages, the two former are not excelled by any other medicines. How far their efficacy is due to the iron, and how far to the acid of the compounds, is, perhaps, an unsettled question.

It should be borne in mind, that all preparations of iron are of doubtful advantage and sometimes are positively detrimental, when, even without a positive state of plethora, there is a local debility of certain parts tending to a state of disorganization. This is strikingly the case in pulmonary phthisis. In that affection iron will even increase the probability of hemorrhage by augmenting the bulk of the blood and the force of the circulation, unless administered with a careful reference to the ability of the system to sustain the increased tension of the bloodvessels. The same remark is applicable to the treatment of ulcerated cancerous and other tumors. It is true, however, that in hemorrhage from the lungs the subsulphate, the perchloride, and other astringent preparations of iron may be of signal service when inhaled by insufflation, or with watery vapor from an atomizer, as will be more fully described in connection with the local applications of iron.

Organic Disease of the Heart.—It is a fact that, in certain cases, cardiac murmurs disappear under the administration of chalybeates. This is, indeed, familiar to every one so far as regards inorganic murmurs, but it is less generally known that sounds which present all the evidences of being generated by organic alterations of the

[1] Compare Abeille Méd., xvii. 67; Bull. de Thérap., lviii. 279 and 441; Ibid., lxxiv. 174; Bull. de l'Acad. de Méd., xxv. 686, etc.

valves or orifices, are sometimes diminished or cease under the treatment referred to. Whether the change in question depends upon the improved condition of the blood, rendering it less capable of generating sonorous vibrations, or whether the medicine acts by imparting greater vigor to the muscles of the heart itself, or whether, finally, in some cases the mechanical conditions for generating sound and depending upon the state of the valves, etc., are favorably modified, it would be difficult always to decide, but of the fact, as stated, there can be no doubt. The accurate and methodical experiments of Pokrowsky, which have already been referred to, prove that dropsical effusions in the cellular tissue, and depending upon mitral obstruction, may be removed under the influence of iron, and that the increase of the heart's impulse and the attending dyspnœa subside under the same medicine. A similar operation must necessarily modify and diminish the signs which indicate the existence of the lesions referred to.

Nervous Affections. Neuralgia.—Neuralgia of the fifth pair of nerves has long been treated successfully by means of iron; especially, if not exclusively, those cases in which the disease depends upon, or is at least associated with, general debility and anæmia. It was first recommended by Dr. Hutchinson,[1] who made use of the precipitated carbonate, and in much larger doses than it had been customary to give in other affections, viz: from forty to sixty grains two or three times a day, for many weeks together. He was careful not to employ it when inflammatory symptoms were present, and always used "collateral means of relief in conjunction with the iron." Many English and some continental physicians published isolated cases showing the success of this method. Among them were some examples of amaurosis with severe neuralgia of the fifth nerve, as in a case of Dr. Belcher.[2] Other instances of the cure of various forms of neuralgia are recorded by Wolff,[3] Duparcque, Melier,[4] etc. The cases of external neuralgia which are most amenable to this remedy are undoubtedly those in which the fifth pair of nerves is affected. Neuralgia of the intercostal and lumbar nerves often yields to it, and occasionally that of the arm; but neuralgia of the lower extremities is more curable by a different class of remedies. Of internal neuralgia, that of the stomach is the only one that is much benefited by iron, and this especially when it is associated with general anæmia in the female, and particularly with uterine derangements and leucorrhœa.

Chorea.—Iron was first used systematically as a cure for chorea by Dr. Elliotson, who published eight cases of its successful administration.[5] He did not find "even headache, vertigo, and symptoms of a degree of paralysis" to interfere with its advantageous employment. But he evidently refers to these symptoms only as they accompany anæmia. Dr. Elliotson found it necessary to con-

[1] Cases of Neuralgia Spasmodica, commonly called Tic Douloureux, successfully treated, 2d ed., Lond. 1822.

[2] Edinb. Med. and Surg. Journ., xxv. 37.

[3] Journ. des Progrès, iii. 237.

[4] Bayle, Bibl. de Thérap., iv. 285.

[5] Med.-Chir. Trans., xiii. 244.

tinue the use of the medicine for six or eight weeks, or even longer.[1] M. Faivre d'Esnans professed to have cured chorea with prussiate of iron in the space of from four to eight days. He administered a little more than half a grain of the medicine three times a day.[2] It is true, also, that he gave valerian freely. Dr. Peacock has reported two cases cured by carbonate of iron.[3]

Some other nervous affections have occasionally been benefited by preparations of iron. Dr. Elliotson reported a case of traumatic *tetanus* which recovered under the use of the subcarbonate.[4] Mr. Cline found the muriated tincture successful in overcoming *spasmodic retention of urine* connected with stricture of the urethra.[5] *Seminal emissions*, independent of any general or local excitement, are greatly benefited by the carbonate and other preparations. The tincture of the chloride is particularly indicated in those numerous cases in which the emissions occur in connection with excellent general health, and without being solicited by any genital stimulation, but merely as the result of an exuberant secretion during adolescence. Such cases should be cured as soon as possible, for they tend towards despondency and even worse.

Among the various remedies which have been employed to cure *nocturnal incontinence of urine*, iodide of iron deserves a prominent place. Of course the indication for special treatment will depend mainly upon the cause of the infirmity, which is sometimes removable, as where it consists of piles, ascarides, calculus, excessive acidity or alkalinity of the urine, etc. But when, as often happens, no such condition can be discovered, a great variety of means both general and local have been employed to give tone and contractility to the muscles of the neck of the bladder, or to allay the supposed morbid sensitiveness of its nerves. These means include, as local applications, nitrate of silver, blisters, iodine, veratria, morphia, etc., and as internal medicines camphor, lupulin, the bromides, ergot, and belladonna. Like most other physicians we have found the last two agents the most reliable; but there are cases which resist them and which haply may yield to the use of iodide of iron as proposed by Dr. John Barclay.[6] He made the discovery of its virtues in this affection accidentally, but found them real both in his own hands and in those of many other physicians. He prescribed fifteen or twenty minims of the *syrup of iodide of iron* properly diluted to be taken after every meal. In *paralysis of the bladder* depending upon causes residing in the organ itself and especially on vesical catarrh, the administration of the tincture of the chloride of iron is sometimes an efficient remedy. It has even proved to be so when injected into the bladder.

Insanity, of the hypochondriac or hysterical sort, in anæmic persons, is beneficially affected by these medicines, particularly when they are combined with narcotics. Under a similar state of the

[1] Pract. of Med., 2d ed., p. 695.
[2] Lancet, April 6, 1850, p. 413.
[3] Times and Gaz., April 1855, p. 410.
[4] Med.-Chir. Trans., xv. 161.
[5] M d. Records and Researches, p. 83.
[6] Times and Gaz., Dec. 1870, p. 697.

system, Dr. Stanger found sulphate of iron successful in curing an obstinate spasmodic cough which had resisted the use of narcotics.[1] Steymann first proposed carbonate of iron as a remedy for *whooping-cough* during the convulsive stage of the disease. He prescribed about one grain every three hours, and gradually increased the dose to three or four grains.[2] Lombard, of Geneva, imitated this practice, and Dr. Graves employed it with advantage. Chisholm,[3] and also Thierfelder, recommended it, and Elliotson and Rees used the sulphate of iron with much benefit. The idea originally entertained that iron is a specific for whooping-cough, is now abandoned, but the medicine continues to be prescribed in cases of feeble and scrofulous children, with a hereditary tendency to tubercles, when no inflammatory complication opposes its use.

Chronic Intermittent Fever.—In 1822, the prussiate of iron and potassa was recommended by Dr. Zollickoffer, of Maryland, as a substitute for bark in the cure of intermittent fever in cases where the latter could not be borne, or when, as in children, its administration was difficult. His favorable accounts of its operation were confirmed by Hosack and Eberle, and by Dr. Jackson, of Northumberland, Pa.,[4] who prescribed it in doses of from one to two drachms during the apyrexia. It was partially recommended also by Fahnestock, who, however, alleged that in some cases it produced "violent cerebral excitement, excruciating pain in the temples, restlessness, and delirium, and in one case death."[5] It is certain that a very impure preparation must have been used in these cases. Owing partly to such statements, but still more to the introduction of quinia, the use of Prussian blue appears to have been abandoned.

The cachectic and anæmic condition resulting from chronic intermittent fever, and still more from a prolonged residence in malarious districts, and which is a cause of great bodily debility, mental irresolution, and susceptibility to repeated attacks of the disease, has long been treated by ferruginous medicines, which restore the blood to its normal condition, and thus infuse new life and activity into all the functions. The reader will have noticed that iron was anciently esteemed one of the most efficient remedies for enlargement of the spleen. Modern observation has confirmed this opinion so far as the engorgements in question result from periodical fevers, or the habitual operation of their cause. They are then generally connected with a greater or less degree of anæmia. In most instances the efficacy of the medicine is greatly increased by its being associated with the preparations of bark. M. Cruveilhier is one of those who in recent times has drawn particular attention to this quality of iron.[6] The sulphate and the carbonate of iron, the citrate of iron and quinia, and the solution of nitrate of iron, have been employed successfully under the circumstances referred to. The last-named

[1] Med.-Chir. Trans., 13.
[2] Bull. de Thérap., xiv. 148.
[3] Month. Journ. of Med. Sci., ii. 22.
[4] Am. Journ. of Med. Sci., ii. 335.
[5] Ibid., iii. 244.
[6] Dict. de Méd. et de Chir. Prat., Art. Fer.

preparation has been recommended by Mr. Kerr,[1] and we imagine that, possessing, as it does, like the muriated tincture, direct tonic as well as reconstituent properties, it may be superior to the milder and less soluble salts.

Abdominal Affections.—In those forms of *dyspepsia* which depend upon general debility and impoverishment of the blood, as in chlorosis, iron is often essential to the cure. Some of its preparations also, especially those combined with a mineral acid, may act as local stimulants. In other cases it is most effectual when associated with bitter tonics, and especially with cinchona or with quinia. When the stomach is irritable the combinations of iron with vegetable acids are peculiarly advantageous. When constipation is present in anæmic cases, iron is sometimes adequate to the cure, by imparting an increased tone to all the functions, and probably also by augmenting the nutrition of the muscular coat of the intestines. Under other circumstances, all of its preparations, except the potassio-tartrate, tend to produce constipation, and make it necessary to prescribe laxatives from time to time.

Albuminuria.—The treatment of this affection generally pursued is based rather upon its ultimate effects in the kidneys than upon a just notion of its mode of origin. The more the disease is studied the more probable does it become that the renal lesion, like tuberculization of the lungs, is the effect of a general morbid state, and that the only treatment adequate to arrest its progress must be addressed not so much to the kidneys as to the blood. To be successful, also, it must be employed as early in the disease as the local inflammatory symptoms will permit. The anæmic aspect of persons laboring under albuminuria has been repeatedly described, and is sufficiently apparent, and several writers have incidentally suggested the use of iron to combat this symptom, while they still relied upon local applications as their chief resource. Undoubtedly that form of the disease which is best adapted to the reconstituent treatment is the congestive, when it is unattended with fever, or when the febrile reaction has been subdued and the dropsy reduced by purgatives and saline diuretics. Dr. Lees, of Dublin, was the first to demonstrate the value of ferruginous medicines in the chronic forms of the disorder. He employed the ammonia tartrate of iron in doses of ten grains three times a day. Dr. Owen Rees would restrict the use of chalybeates still more absolutely to the chronic varieties; and, while admitting that there is little hope of effecting a cure, he dwells upon the important indication of supplying red disks to the blood. He sometimes prescribes the preparation named above, but prefers the compound iron mixture, or the wine of iron.[2] Dr. Beale prefers the tincture of chloride of iron, with an excess of muriatic acid given in infusion of quassia.[3] Dr. Basham uses solution of acetate of ammonia as a preferable vehicle; which, however,

[1] Month. Journ. Med. Sci., xiii. 336.
[2] Nature and Treatment of Diseases of the Kidneys, etc., p. 89.
[3] Times and Gaz., Jan. 1865, p. 29.

converts the chloride into an acetate of iron; and Dr. Hassall, by demonstrating the absence both of iron and of hydrochloric acid in the urine discharged during the administration of the medicine, has proved that its efficacy depends upon its power of reconstituting the blood, and not upon any astringent action exerted upon the kidneys or the urinary passages.[1] Dr. Dickinson, also, regards iron of essential advantage in each of the three forms of kidney disease which he associates with albuminuria, tubal nephritis, granular degeneration, and depurative infiltration or amyloid disease.[2] In *dropsy* dependent upon *engorgement of the spleen*, this class of medicines is of primary importance; and the same may be said of general dropsy following miasmatic fevers.

In a marked case of *diabetes* we found that the acetate of iron (Basham's mixture) caused the sugar to disappear from the urine on several occasions, while the amount of urine secreted was but slightly diminished. In another case no appreciable influence on the secretion of sugar was noticed, but the patient's general health improved.

In nearly all *chronic mucous fluxes* the sulphate and the muriated tincture of iron possess unquestionable advantages. In leucorrhœa and blennorrhœa, chronic mucous diarrhœa, bronchorrhœa, and also in passive sweats they are frequently of essential service, provided that no inflammatory fever exists. In atonic mucous diarrhœa the solution of nitrate of iron was originally recommended by Mr. Kerr,[3] and has since been found useful by many physicians, among whom may be numbered Drs. Neligan and Graves, of Dublin,[4] and Dr. Adams, of Michigan.[5]

Intestinal Worms.—Iron is usually ranked among anthelmintic medicines. It is possible that iron filings may occasionally destroy these parasites by a mechanical operation. Tænia is said to have been removed by sulphate of iron. But, in general, ferruginous preparations are only to be relied on when the patient is in that cachectic state which favors the generation of intestinal worms, and by the cure of which the conditions for their continued existence are also removed. Probably the medicine is more successful in preventing their reproduction, after their expulsion by proper medicines, than in destroying them by virtue of any direct anthelmintic quality.

Consumption of the Lungs.—As long ago at least as 1803 it was known that iron is often a mischievous medicine in consumption. At that time Brandis pointed out the evils of an inconsiderate use of chalybeate waters in this disease; Richter alse states that experience shows ferruginous preparations to be seldom well borne by the phthisical; and their observations have been confirmed by

[1] Lancet, Dec 1864, p. 740.
[2] Pathol. and Treat. of Albuminuria, 1868.
[3] Edinb. Med. and Surg. Journ., xxxvii. 99; Month. Journ. of Med. Sci., viii. 784.
[4] Lond. Med. and Surg. Journ., May, 1835.
[5] Am. Journ. of the Med. Sci., xxiv. 61.

writers of the present day. In truth, it is only in an advanced stage of the disease, as a rule, that a true anæmia exists, and even then the alterations of the pulmonary structure are such as tend to induce congestion, and even inflammation. The former process is still more apt to be established in the earlier periods of phthisis. At every period a medicine, the direct agency of which is to augment the quantity and the strength of the blood, without directly improving the nutrition, cannot fail to promote the pulmonary derangement referred to, and to increase the chances of hemorrhage. Whatever advantage the preparations of iron may afford the consumptive by improving the crasis of the blood, is more than counterbalanced by the increased tendency to congestion which they develop, and, above all, to hemorrhage of the lungs. The indication for the use of iron in phthisis which Morton long ago presented for our guidance, has lost nothing of its truth or of its practical value. He speaks of having prolonged the lives of many consumptive patients for years, by causing them to use chalybeate waters in the summer, provided, "the hectical heat" were "moderate and almost insensible;" to which he might have added, if the tendency to hæmoptysis were slight or entirely wanting.

The subject of the use of iron in phthisis has recently had much attention paid to it, and has inspired some writers with a panegyric of the medicine which the most intelligent and reliable experience has not justified. Nearly twenty years ago, M. Dupasquier, of Lyons, published very remarkable statements, respecting the virtues of iodide of iron in all the stages of consumption, and even attributed to it a certain number of real and permanent cures. Unfortunately for his credit, this excellent physician having himself furnished directions for the preparation of his remedy at the Beaujon Hospital, in Paris, M. Louis, one of the visiting physicians at the time, administered the medicine to more than sixty of his patients at the hospital and in private practice affected with phthisis in different stages. "In not a single case did I observe any improvement that could be attributed to this new remedy," was the verdict pronounced by M. Louis.[1] But Dr. Cotton, of the London Hospital for Consumption, appears to have been more fortunate, for he found that in six out of twenty cases of incipient phthisis, the disease seemed to be arrested.[2] In his subsequent publications upon the subject,[3] his encomiums are a good deal modified, and might, perhaps, be justly so in a greater degree, if the share in the improvement of his patients due to cod-liver oil had received a just allowance. He concluded, however, that iron, and especially the sesquichloride, is "perhaps more valuable than any other remedy with which we are at present acquainted." Dr. James Jones,[4] on the other hand, awards the superiority to the tincture of the chloride, which he very properly does not propose

[1] Recherches, etc., sur la phthisie, 2ème ed., p. 613.
[2] On the Nature, etc., of Consumption, 1852, p. 279.
[3] Times and Gaz., 1860–63. [4] Ibid., Mar. 1862, p. 292.

as a substitute for cod-liver oil, each of these agents having a distinct function to perform in aiding nutrition and promoting healthy sanguification. He also insists that the dose of whatever preparation is selected should be so small as to be perfectly assimilated, a precaution that is too often neglected, and from which impaired digestion and mal-assimilation are apt to result. Nor does this writer record any such marvellous examples of the cure of phthisis which some of those we have referred to have ventured to publish, nor does he call in question such proofs of the incendiary nature of the treatment by means of iron as others have placed on record. Millet, of Tours, assures us that he has seen more than sixty cases in which treatment by iron was followed by a rapidly fatal termination of the disease, and he dwells upon the danger of administering the preparations in question to those young females who present, as the earliest indications of the pulmonary affection, the general signs of chlorosis, viz., pallor and loss of flesh, with a short, dry cough.[1]

They are equally pernicious when the condition exists which Barbier long ago described as follows: "When the vital condition is irritable, when the pulse is quick and frequent, and there is a tendency to inflammatory complications." The most appropriate cases for their use are those in which the constitution is dull and lymphatic, when the disease advances slowly, and without inflammatory or congestive complications; and in these, also, it may be added, the greatest benefit is derived from cod-liver oil.

While, however, these objections exist to iron as a remedy in phthisis, there are qualifying considerations, which ought not to be overlooked. The dangers that have been pointed out arise in part from the blood having been rendered too abundant and too rich for the wants of the system. But if, simultaneously with the use of the medicine, means are taken to employ the excess of blood for the purposes of nutrition, iron may become of great value in the plan of treatment. If, for example, the patient is directed to use as much exercise as possible in the open air, to increase the action of the skin by frictions, and, in the proper season, by cold bathing, he will probably be benefited by the use of iron. This, at least, is the case in the more chronic forms of the complaint, and before hectic symptoms have appeared. The medicine should also be suspended, or its dose diminished, whenever oppression in breathing, fulness of the head, or a too active pulse, gives warning of the dangers of plethora.

Scrofula.—Considered as an independent disease, scrofula is not under the influence of iron; but whenever it is complicated with anæmia, and, in females, with menstrual derangements, these affections should be treated with iron as if they existed independently. The iodide is thought to be peculiarly adapted to such cases, and the most eligible form for the administration of iron in phthisis.

Connected with a strumous diathesis, if not with developed

[1] Bull. de Thérap., lxii. 507.

scrofula, is a cachectic condition which is very common among children, and which among the poor is the immediate effect of coarse and ill-prepared food, and among the wealthier classes results from overfeeding or from pampering the appetite with confectionery or highly seasoned viands. It is distinguished by a tumid abdomen, a pale face, thin limbs, a capricious appetite, and irregular and slimy dejections, often containing worms. In such cases iron is of great value, but it should be associated with vegetable tonics, and especially with bark or its alkaloids, and a saline purge or castor oil should occasionally be administered.

Constitutional Syphilis.—Few diseases induce anæmia more perfectly than this, and one of the greatest obstacles to its cure is the impaired activity and regenerative power of the circulating fluid. Such is particularly the case when mercurial medicines have been too lavishly administered, and when the ulcerated flesh and carious bones seem unable, from absolute debility, to set on foot the healing process. Cullerier, Ricord, Ratier, Behrend, and others have used the potassio-tartrate, and other salts of iron, with advantage in those cases of primary syphilis in which the constitution is impaired, and the sore assumes a phagedenic character. Behrend believes that, even in general, the cure of the ordinary primary chancre is hastened by this treatment.[1].

Cancer.—Iron was resorted to in the treatment of cancer by Poteau, and by Justamond, both internally and externally, and the latter reported that the ammonio-chloride of iron (*Flores Martiales*) was competent to the cure or the amendment both of the open and the occult disease. This treatment was also adopted by Carmichael,[2] and he with several other practitioners obtained results from its administration, which, in the opinion of Dr. Walshe, strongly entitle it to notice.[3] It is unnecessary to detail the experiments that have been made with reference to this subject. That iron sometimes palliates the cancerous cachexia, and the anæmia which occurs when the system has begun to waste under the influence of open cancer, there can be no question; but there is no evidence whatever that it has ever removed or even arrested the specific derangement of nutrition which constitutes cancerous disease.

Erysipelas.—Mr. G. H. Bell, of Edinburgh, first called attention to the efficacy of the tincture of chloride of iron in idiopathic *erysipelas.* In 1851, when he published an account of this treatment, he stated that he had made use of it for twenty-five years without having, in a single instance, failed of success. His practice was, in mild cases, to give fifteen drops of the medicine in water every two hours, until the disease was completely removed. In severer cases the dose was twenty-five drops, "persevered in night and day, however high the fever and delirium." He used, at the same time, cotton wadding and hair powder as a local application. Dr. C. Bell

[1] Times and Gaz., Nov. 1856, p. 534 and p. 673.

[2] An Essay on the Effects of Carbonate and other preparations of Iron, upon Cancer, 2d ed., Dublin, 1809.

[3] Walshe, On Cancer, p. 197.

confirmed the above statements by the results of his own practice, and extended the use of the remedy to traumatic erysipelas.[1] Dr. Balfour found it "a certain and unfailing remedy in erysipelas, whether it were infantile or adult, idiopathic or traumatic;"[2] and these accounts are confirmed by Mr. Hawkes.[3] Vallette and Mathey;[4] and, later, Aran, in France, Dr. Pirrie, Jr., and others in England and in this country, have shown that the solution of the chloride of iron (perchloride) possesses an equal degree of efficacy. Of the two preparations the former is the less disagreeable to the taste, and, from our own observations, as well as from the recorded experience of others, judging that it is equally efficacious, we should give it the preference over the perchloride. While it is true that erysipelas is usually a self-limited disease, and that consequently the influence of treatment upon it is difficult to estimate, the results which are given above are too positive, too numerous, and extend over too long a series of years to permit our regarding them as deceptive. It was to be expected that further observation of its use would modify the estimate at first made of the value of the treatment of this disease by the chlorides of iron. According to Dr. R. J. Lee[5] the average duration of a certain number of cases treated by him with these medicines was several days longer than that of an equal number under "general treatment." Questions such as this can only be decided by a careful comparison of a large number of similar cases under different methods of treatment. The summary just adduced is a contribution to the solution of this question, but not of itself decisive. Meanwhile, although sometimes disappointed in the effects of the medicine, we are too strongly impressed by the power it has seemed to exhibit in many severe cases, to abandon its use without more convincing proof of its inutility.

The claims of iron appear stronger when it is remembered that erysipelas is not the only exanthem which seems to have been cured by the preparation in question. Dr. H. S. Byrd, of Savannah, states that having employed it in erysipelas with success, he conceived that such an analogy exists between that affection and *scarlet fever*, as to warrant his trying the medicine in the latter disease. He accordingly prescribed it in doses of three or four drops every four hours, and in upwards of twenty cases. So persuaded was he of its value, as to declare "that he would not exchange it for all the other remedies which he had before used in scarlet fever."[6] Several years later, and influenced by the same analogy, Mr. Meade, of Bradford, Eng., adopted the same practice, and with like success.[7] From its analogies and its frequent association with erysipelas, it has been suggested that the adynamic form

[1] Month. Journ. of Med. Science, xii. 497.
[2] Month. Journ. of Med. Sci., xvi. 428.
[3] Lancet, Feb. 1856, p. 151.
[4] Abeille Méd., 1857, p. 233. Bull. de Thérap., liii. 12.
[5] Practitioner, viii. 158. [6] Charleston Med. Journ., ix. 155.
[7] Lancet, June, 1858, p, 661.

of *puerperal fever* might be successfully treated with the chloride of iron. In the absence of any tangible and conclusive evidence upon the subject, we can only subscribe to the opinion that a fair trial of the medicine in this disease is greatly to be desired. It may also be noticed, that Mr. Kerr found the solution of nitrate of iron very beneficial in several cases of *urticaria*, or rather of gastric dyspepsia attended with this eruption.[1] These facts are of sufficient importance to be remembered by medical practitioners, and brought to the test of a wider experience.

The apparent utility of tincture of chloride of iron in various febrile affections seems to have led to its use for one in which, under the medical doctrines until lately supreme, it appeared to be peculiarly inappropriate. We refer to *rheumatism*, in which, according to Dr. Reynolds, who first employed the treatment, its "relief of the joint affection was definite, uniform, and speedy; and no unpleasant symptoms were produced by the medicine."[2] These conclusions were partially supported by the evidence of Dr. Anstie,[3] who, however, attached more importance to the power of the medicine in preventing the development of the rheumatic attack in persons affected with its premonitory symptoms, of which he enumerates the following: Obscure aching of the joints, yellow sallowness of the face, a furred tongue, and a feverish pulse. This evidence upon the subject (and it is all that we possess) does not appear to encourage a resort to a method as opposite as possible to the alkaline plan, in proof of whose efficacy in acute articular rheumatism we possess the most incontrovertible proof.

As antidotes to metallic poisons, preparations of iron are employed. M. Sandras, believing that *lead*, like some other mineral poisons, is excreted by the liver, and again absorbed into the system from the intestine, proposed, by administering a syrup of the sulphuret (*persulfure*, according to M. Sandras; *protosulfure*, according to M. Mialhe) of iron, to render the excreted particles insoluble, and, therefore, incapable of reabsorption.[4] However ingenious this expedient may be, a resort to it is unnecessary while we possess the iodide of potassium.

M. Mialhe states that the hydrated protosulphuret of iron[5] which is, itself, completely inert, decomposes *corrosive sublimate*, producing the protochloride of iron and the bisulphuret of mercury, both perfectly innocuous substances; and that it also neutralizes other metallic poisons, such as arsenious acid, the salts of tin, lead, bismuth, antimony, copper, silver, gold, etc. As regards *arsenic*, the most important of these poisons, in relation to the present subject, however its chemical relations, when it is in a state of solution, may

[1] Month. Journ. of Med. Sci., May, 1848, p. 787. [2] Brit. Med. Journ., 1869, ii. 649.
[3] Practict., vii. 158. [4] Bull. de Thérap., xlix. 126.
[5] This compound is prepared by "dissolving protosulphate of iron with twenty times its weight of boiled water, and precipitating the iron by means of hydrosulphite of soda or ammonia likewise dissolved in water containing no air. The precipitate is washed with similar water, and kept in glass-stoppered bottles, containing distilled water."—*Mialhe.*

favor its precipitation by the hydrated oxide of iron, there is strong reason to suppose that in ordinary cases of arsenical poisoning, the greater part of the poison remains undissolved in the stomach, and that the iron, in so far as it is useful, operates chiefly as a mechanical antidote, by enveloping the arsenic, and thus shielding the stomach until emetics cause its discharge. Dr. Kohler, of Halle, has proposed the soluble saccharine oxide of iron as preferable, on account of its retaining its antidotal qualities for an indefinite period.

Local Uses of the Preparations of Iron.—The acid compounds of iron, and particularly the *sulphate*, the *tersulphate*, the *subsulphate*, and the watery solution and the tincture of the *chloride*, have been employed topically in various diseases in which a local astringent action is desired.

Velpeau, making very important distinctions between *erysipelas*, phlebitis, diffused phlegmon, and lymphangitis, claimed that in the first-named of these affections the topical application of a solution or of an ointment of *sulphate* of iron, is a more efficient treatment than blisters, nitrate of silver, mercurial or simple ointment, or any other of the topical remedies which, in the course of his long experience, he had employed. He used a solution of half an ounce of the sulphate to a pint of water, and an ointment containing two drachms of the salt to an ounce of lard. The latter preparation, which appears to be preferable, should be made with the salt very finely pulverized, and applied three times a day upon the erysipelatous surface.[1] These remarks apply to traumatic erysipelas only. A solution of sulphate of iron has been used as a lotion in *phlegmasia alba dolens* with alleged beneficial effects;[2] but as the muriated tincture of iron with quinia was given internally, the benefits of the lotion remain to be proven. Devergie employed an ointment made of one or two parts of sulphate of iron to thirty of lard, with great success, in obstinate cases of *eczema*, *intertrigo*, and *impetigo*, occurring in patients of a lymphatic constitution. In squamous affections it was useless.[3] The same physician found the solution of the chloride extremely useful in promoting the cure of ill-looking ulcers, as those of *rupia*, *ecthyma cachecticum*, *syphilis*, and *scrofula*. When very strong, an ointment of sulphate of iron, or a solution of corresponding strength, acts slightly as a caustic upon delicate tissues.

A solution of persulphate of iron has often been used with advantage in the treatment of nasal and aural *polypi*, to harden delicate *nipples*, and to cure *fissures* of these organs. It acts still better as a corrective of excessive and depraved mucous secretions, such as chronic *gleet* and *leucorrhœa*, and gives strength to the relaxed membrane. The solution of the chloride of iron has also been used in such cases, and with especial benefit in repressing fungous granu-

[1] Bull. de Thérap., xlviii. 15, and lviii. 289.
[2] Brit. Med. Journ., Oct. 1871, p. 466.
[3] Bull. de Thérap., xlvii. 553.

lations, as from *ingrown toe-nail*, in curing destructive *ulceration of the gums*, etc. Its energy exceeds that of the sulphate. In a case of *gleet*, treated by injections of the former substance, fatal inflammation of the bladder ensued; in two other cases urethral hemorrhage was produced in the same manner.[1] Even in *hemorrhage* from slight wounds, or from the surface of an integument, the sulphate of iron is sometimes an efficient application. It is less so, however, than the *chloride*, which has been found successful, after the failure of other hæmostatics, in epistaxis, in hemorrhage from leech-bites, from the jaw after the extraction of teeth, from the tonsils, from cancerous ulceration of the neck of the uterus,[2] from the umbilical cord, and in arresting uterine hemorrhage during or subsequent to abortion.[3] Braun and others successfully employed this preparation in various affections of the interior of the body and the neck of the uterus, not only to correct hemorrhage, but also to modify the diseased surface of the organ. Maisonneuve used it to arrest hemorrhage during the excision of a fungous tumor of the dura mater.[4] Powdered subsulphate of iron (Monsel's salt) has been applied successfully to arrest hemorrhage from an excised tonsil. To Dr. Robert Barnes is due the introduction of perchloride of iron as a local application in certain cases of *uterine hemorrhage* after labor. He employed a solution consisting of half a pint of "liquor ferri perchloridi fortior," B. P., diluted with a pint and a half of water, and directed that a tube about nine inches long should be introduced to the fundus of the uterus previously freed from clots with the left hand, and that the liquid should be *very slowly* pumped in, care being taken that no air accompany it. Dr. Barnes states that he has never known a single injection to fail in arresting the hemorrhage, even after the failure of all other means.[5] Mr. Morris has furnished confirmation of the efficacy of this measure, by citing ten cases of its success both in directly arresting bleeding and in producing permanent contraction of the uterus;[6] and Dr. Roe has reported three cases to the same effect.[7] In numerous cases of *pulmonary hemorrhage* due to disease of the lungs, and threatening danger to life by its excess, the flow of blood has been promptly arrested by the inhalation of an atomized weak solution of perchloride of iron.[8] Dr. Sternberg reports the very interesting case of a man who received a penetrating wound in the lung, followed by profuse hæmoptysis. Other remedies had been used in vain, when Dr. S. employed a hand-atomizer with a long tube, by which the spray was thrown into the lungs during each inspiratory act. The solution used consisted of one part of tincture of chloride of iron to ten parts of water, and was employed twice for a minute at a time. The bleeding then

[1] Bull. de Thérap., iii. 236.
[2] Rémilly, ibid., xlv. 512.
[3] Schreier, Phil. Med. Ex., Dec. 1855, p. 725.
[4] Brit. and For. Med.-Chir. Rev., xviii. 261.
[5] Lancet, Jan. 1869, p. 175.
[6] Brit. Med. Journ., April 10, 1869.
[7] Dublin Quart. Journ., Nov. 1870, p. 229.
[8] Bull. de Thérap., lxxv. 134; Ranking's Abs., xlvi. 57.

ceased, and did not recur.[1] A very obstinate and dangerous case of *epistaxis* is reported, in which a diluted solution of chloride of iron injected into the nostril posteriorly and anteriorly, certainly arrested the flow when the death of the patient seemed inevitable.[2] It may be used also to stop *gastric hemorrhage* in any of the various conditions under which this accident occurs.

Although the idea of treating *aneurisms* by injecting them with an astringent substance had been proposed by Monteggia in 1813, and by Leroy d'Etiolles in 1844,[3] yet to Dr. Brainard, of Chicago, belongs the credit of having first coagulated the blood in a vascular tumor by injecting it with a solution of a salt of iron. In November, 1851, he successfully treated an erectile tumor of the orbit by injecting it, by means of an infiltrating canula, with a solution of eight grains of *lactate* of iron to a drachm of distilled water.[4] In January, 1853, M. Deslongchamps used a watery solution of the chloride of iron in the same manner, and with complete success, in the treatment of a varicose aneurism of the forehead,[5] and similar instances of its use were reported by Serre (d'Alais), Valette, of Lyons, and by Lawrence, Cock, and Hilton, of Guy's Hospital.[6] This operation appears to be not always unattended with danger. An infant a month old had injected into a varicose tumor of the nose five drops of the solution of perchloride of iron; the child cried out, was seized with a spasm, and died. In another similar case, it was found after the child's death that the canula of the syringe had pierced the transverse vein of the face, and that the right side of the heart was filled with a clot.[7] M. Pravaz illustrated the remarkable coagulating power of this substance by his experiments upon animals. But whether it is that the method is not uniform in its effects, or whether it has been imprudently applied, its use occasionally is followed by severe inflammation and suppuration in the neighborhood of the aneurismal sac, or by ulceration of the latter. A case of popliteal aneurism, in which M. Lenoir employed this method, terminated fatally with symptoms of phlebitis.[8] In other cases, again, the operation was purely negative in its effects, and a cure of the disease was afterwards obtained by ligature. Jobert was of opinion that it should be reserved for traumatic aneurisms of recent formation, and free from inflammation, and that it is dangerous when the aneurismal sac is inflamed, or is likely to be unsound.[9] M. Malgaigne, in a report to the Academy of Medicine, states that out of eleven operations, in which this method had been used, "there had been four deaths, five serious accidents, and two cures;" and he concludes by saying that "no prudent surgeon would venture to expose his patient to so disastrous a mode of treatment."[10] In a case of extensive aneurism Drs. Minor and Isaacs, of New York, used a solution of the chloride of iron

[1] The Med. Record, ii. 534.
[2] Bull. de Thérap., lxxix. 188.
[3] Ibid., xliv. 465.
[4] Lancet, Aug. 20, 1853.
[5] Bull. de Thérap., xliv. 304.
[6] Times and Gaz., March, 1857, p. 286.
[7] Bull. de Thérap., lxxii. 476.
[8] Ibid., xlv. 369.
[9] Ibid., xlvi. 447.
[10] Bull. de l'Acad., xix. 101, 104.

with perfect success; yet, in their hands, with every precaution taken, the local irritation was so great as to cause the coagulum to be discharged by suppuration."[1] In two cases of castration in which consecutive hemorrhage was arrested by this compound, peritonitis with bloody and purulent infiltration, and death ensued.[2] Mr. Carter and others have more recently published examples of the dangerous consequences of this plan of treatment. M. Bonjean proposed the addition of ergotin to the solution of chloride of iron, as a means of lessening its irritating qualities, and of augmenting its styptic power;[3] and M. Leclerc cured *vascular nævus* by applying to the cutis (previously denuded or not of its epidermis) compresses soaked with a solution of the chloride. By this means a gradual but complete removal of the tumor was obtained.[4]

M. Burin de Buisson has attempted to show that a "neutral chloride of iron" is quite as powerful in coagulating blood as the acid salt, and that, indeed, the latter, by carbonizing the blood, impedes the ultimate absorption of the clot, and even cauterizes the internal surface of the pouch. M. B. states that the salt recommended by him has no such action, and may be taken internally, without danger, in doses of from fifteen to thirty grains, properly diluted.[5] On trial, however, this preparation is alleged by others to be as mischievous as the acid compound.[6]

Dr. Minor, of New York, has reported several cases of *varicose veins* successfully treated by injecting them with a solution of persulphate of iron, of the strength of one part of the salt to two, three, or four of water. This operation is characterized as safe, prompt, and painless. It was performed with Tiemann's modification of Pravaz's syringe, while the vein was compressed above and below the point of puncture. Caron has shown that a solution of chloride of iron may be employed in this affection with an equal degree of success and with as little danger of injurious consequences.[7]

Several physicians of Paris have used the solution of chloride of iron with marked success in the treatment of *ophthalmia*, with enlargement of the bloodvessels upon the surface of the cornea; a form of disease notoriously rebellious to ordinary modes of treatment.[8] This preparation has also been found useful as an application to the pharynx in *diphtheria* at the same time that it was administered internally. Schaller, from his own experience, furnishes analogous statements of the value of this medicine as a topical application in various forms of angina besides the diphtheritic.[9] A large number of physicians, in France particularly, have furnished the most encouraging reports of its efficacy, which appears to be far greater than that of nitrate of silver, and indeed of all other stimulants and caustics. Dr. Farnsworth,[10] of Iowa, has shown that the per-

[1] Trans. Med. Soc. of the State of New York, 1860, p. 18.
[2] Lancet, March, 1861, p. 279.
[3] Bull. de Thérap., xlviii. 362.
[4] Ibid., xlix. 518.
[5] Ibid., xlv. 263.
[6] Ibid., xlv. 366.
[7] Arch., Gén., Dec. 1857, p. 710.
[8] Follin, Arch. Gén., 5ème sér., vii. 424; Broca, and others, Annuaire de Thérap., 1857, p. 172.
[9] Practitioner, v. 114.
[10] Am. Med. Times, vi. 64.

sulphate is also efficient in this disease. He states that having burned his finger while attending upon diphtheritic patients, the injured part became covered with a false membrane. An application of nitrate of silver aggravated the inflammation, but a solution of persulphate of iron dissolved the membrane and cleaned the sore, which afterwards speedily healed. A strong solution of the chloride is said to be an efficient topical remedy for *chilblains*.

Administration.—*Powder of iron* may be given in the dose of *two* or *three grains*, and from that to six grains, three times a day, mixed with syrup or molasses, or simply diffused in water. It may also be prescribed in the pilular form with sugar, or in pastilles of chocolate, which are allowed to dissolve in the mouth.

The preceding, and all of the insoluble preparations of iron, should be administered immediately before, during, or after meals. The *hydrated sesquioxide*, which is used only as an antidote to arsenic, should be given without stint.

Subcarbonate of iron may be prescribed in doses of from five to thirty grains. The medium dose of the *pills of carbonate of iron* is five grains three times a day; but in the beginning the dose should not exceed two or three grains. All of the foregoing preparations ought to be associated with bitter vegetable tonics in the beginning, at least, of their administration, whenever the digestive process is conducted feebly and laboriously.

The *compound mixture* and the *compound pills of iron*, supposed to have a peculiar adaptation to cases in which menstrual irregularity, anæmia, and a tuberculous cachexia are present, may be administered, the former in the dose of one or two fluidounces, and the latter in that of two or three pills several times a day.

Sulphate of iron, after having been deprived of its water of crystallization, may be given in pilular form, in the dose of one or two grains. The crystallized salt may be administered in a sweetened liquid, and in the dose of from one to five grains. As a lotion for cutaneous eruptions, and as an injection for the cure of mucous discharges, a solution containing from five to fifteen grains to the ounce may be employed; but in erysipelas, as already stated, Velpeau used a solution of half an ounce of the sulphate dissolved in a pint of water.

The *sulphate of iron and ammonia* may be given in doses of from three to fifteen grains two or three times a day.

The dose of *solution of subsulphate of iron* is from five to fifteen drops largely diluted.

Solution of nitrate of iron may be given in doses of from five to thirty drops three times a day, diluted with a sufficient quantity of water.

Phosphate of iron may be prescribed in pill or powder, and in doses of from five to ten grains, and the hypophosphite in the same dose.

Tartrate of iron and potassa is preferably given in solution, and in doses of from five to twenty grains three times a day, when the stomach is empty.

Tartrate of iron and ammonia, and citrate of iron, which are not preferable to the tartrate of iron and potassa, may be given in the same dose as that salt.

Citrate of iron and quinia is prescribed in pilular form, or in syrup, and in doses of from one to five grains before or after each meal.

The *citrate of iron and strychnia* contains in every one hundred grains of the salt one grain of strychnia. Its primary dose is from one to two grains.

Lactate of iron may be prescribed in the dose of from five to forty grains.

Tincture of chloride of iron or *muriated tincture of iron* is administered in doses of from ten to twenty or thirty minims appropriately diluted with water. The dose of the *solution of the chloride* of iron is from one to ten minims administered in syrup. The astringent effect of these preparations upon the mouth and fauces may be diminished by a gargle of milk. The solid chloride of iron, if kept in a bottle, gradually deliquesces, and may be applied by means of a glass brush. For ordinary use as a hæmostatic from three to five parts of the chloride may be dissolved in one hundred parts of distilled water and applied upon lint. The ethereal tincture of Bestuscheff is given in doses of from ten to eighty drops, two or three times a day, upon sugar or in sweetened aromatic water.

Syrup of iodide of iron may be prescribed in doses of from ten to fifty drops in water or other diluent. To protect the teeth from discoloration, the mouth should be rinsed after each dose.

The daily dose of the ferrocyanide of iron is stated by Trousseau at from thirty grains to five drachms. This and similar statements of other physicians favor the opinion that the medicine is inert.[1]

MANGANESII OXIDUM NIGRUM.—*Black Oxide of Manganese.*

This substance is a binoxide of the metal manganese. Owing to the chemical analogies of manganese and iron, and the fact that the former has been detected in several of the humors of the body, especially in the bile, it was concluded that it should possess qualities analogous to those of iron, and might be used with advantage to reinforce the action of that metal. This was first proposed in 1849 by Hannon, a Belgian physician, and by Pétrequin of Lyons, who claimed for the associated medicines effects very far superior to those of either alone, especially in cases of anæmia and chlorosis, and of nervous affections due to impoverishment of the blood. Several other physicians reported more or less favorably of the compound, but the medical profession generally was incredulous regarding the virtues of an unknown medicine when

[1] In this place it would once have been proper to describe the qualities and properties of PEPSIN; but experience having shown that the notions entertained for a time of its virtues were illusory, and as the history of this preparation has furnished a fresh demonstration of the rule that *à priori* conclusions in therapeutics are generally valueless, any detailed account of its preparation or its uses appears to be superfluous.

associated with one of special and recognized efficiency. In 1864 Dr. Arthur Leared[1] claimed that in cases of *morbid sensibility of the stomach*, presumed to be awakened by the action of the gastric juice itself, cases in which the pain comes on some time after taking food, and in which the tongue has a red surface with prominent papillæ, this substance has the same operation as bismuth without a similar tendency to constipate. Whether this peculiarity, which after all is only one of degree, entitles the black oxide of manganese to a place in the Materia Medica, may very well be doubted. Indeed, the medicine does not appear to have obtained currency among practitioners, nor even to be noticed in the most deserving treatises on diseases of the stomach.

The black oxide of manganese may be given in doses of from five to forty grains.

CINCHONA.

Description.—" The bark of all species of the genus Cinchona, containing at least two per cent. of the proper cinchona alkaloids, which yield crystallizable salts." The word *kina*, in the Peruvian language, signifies bark, and its reduplicate *kinkina*, the native name of the medicine, means the bark of barks. The systematic designation cinchona was applied to the genus of trees producing it by Linnæus, in 1742, in honor of the Spanish Countess Cinchon, who was one of the first to test the febrifuge virtues of the bark. Cinchona trees are found only in South America, in the higher regions of the Andes, where they form a belt of forests extending in a southwest direction from latitude 10° N. to 19° S., and in breadth about forty or fifty miles. They belong to the natural family *Cinchonaceæ*, and to the *Pentandria monogynia* of Linnæus. They are trees or tall shrubs. The leaves are opposite, upon short petioles, with plain margins; the flowers are white or of a purplish rose-color, terminal, arranged in corymbose panicles, and very fragrant. The bark is the only portion of the tree that is employed in medicine.

In commerce cinchona occurs in the form of quills, or flat pieces of various sizes and thickness, and of a brownish-gray, yellow, or red color, of a bitter and nauseous taste, and when powdered, of a somewhat aromatic odor. The size and color of the pieces of bark depend chiefly upon the age of the tree from which it is procured; the finer and more delicate quills being furnished by the smaller branches, and the flat pieces by the larger limbs, or by the trunk of the tree. The former belong to the pale commercial varieties of cinchona, consist of the cellular layer of the bark, and contain chiefly *cinchonia*, while the latter are formed mainly by the fibrous layer, the cellular having been removed by scraping. It is in the fibrous layer that *quinia* chiefly resides, and hence the barks treated

[1] Med. Circular, Jan. 6, 1864.

in the manner referred to, contain but a small proportion of the cinchonia. This is the case with Calisaya bark, the most esteemed of all the varieties.

Water extracts the virtues of cinchona partially, but alcohol more completely; the addition of sulphuric or muriatic acid to either menstruum renders the solution more perfect.

The officinal barks are these:—

1. **Cinchona Pallida.** *Pale Cinchona.*—"The bark of Cinchona Condaminea and of Cinchona micrantha." This variety is in cylindrical rolled pieces or quills. The epidermis is of a grayish color; the true bark is moderately fibrous, more or less brownish or yellowish, and its powder is of a grayish-fawn color. It is astringent rather than bitter, and contains more cinchonia than quinia. The Loxa and Lima barks belong to this variety.

2. **Cinchona Flava.** *Yellow Cinchona.*—"The bark of Cinchona Calisaya." The pieces are larger than those of the pale barks, and are either flat or rolled. They are often destitute of epidermis, and the proper bark has a fibrous texture. Yellow bark is very bitter, and is almost free from astringency. When powdered, it is of a brownish-yellow color, inclining to orange. It is very rich in quinia.

3. **Cinchona Rubra.** *Red Cinchona.*—"The bark of Cinchona succirubra." Barks of this variety are intermediate between the other two. The pieces are either flat or rolled; the epidermis is never detached. The proper bark is fibrous and of a brownish-red color, and both bitter and astringent in taste. It contains both quinia and cinchonia. The powder is of a bright brownish-red color. This variety includes the brown and red barks of Carthagena and Lima.

Besides the above, various other cinchona barks enter into commerce, some of which, like certain of the Carthagena barks, contain little or no quinia, and but a small proportion of cinchonia. Of the barks from New Granada and Venezuela, some contain a very large amount of quinia. Such is the Calisaya bark of Santa Fe. The supply from this new source is likely for a long time to meet the demand, and it is indeed to be chiefly depended upon, especially since it is now ascertained that most of the barks which were formerly employed in the treatment of malarial affections, contain more cinchonia than quinia.

Organic Principles.—The constituents of Peruvian bark are very numerous, but the principal are *quinia*, *cinchonia*, and *quinidia*, which exist in combination with kinic acid, or with a red coloring matter which has all the properties of tannin.

Quinia is a whitish, flocculent substance, inodorous, but extremely bitter and very fusible. It is slightly soluble in boiling and less so in cold water; on the other hand, it readily dissolves in hot alcohol or ether. It is also soluble in the volatile and fixed oils, and with the acids forms crystallizable salts.

Cinchonia, which Huanuco bark contains almost exclusively, is white, crystallizable, inodorous, and bitter, although slightly less

so than quinia, unless in solution, and is but slightly fusible. It dissolves in 2500 times its weight of cold water, but is more soluble in hot water. It is less soluble than quinia in alcohol, and is insoluble in alkalies and ether, and but slightly soluble in the volatile or fixed oils. Like quinia, it forms crystallizable salts with the acids. It is distinguished from quinia by its action with ammonia when dissolved in chlorinated water. Under these circumstances it gives a white precipitate, while that of quinia is green.

Quinidia is an alkaloid isomeric with quinia, and, like that substance, has a bitter taste, but in a less intense degree. Its crystals are unlike those of quinia, in being hard and shining. It is very soluble in alcohol, but is less so in ether, and in boiling water it dissolves very slightly. Its salts are more soluble than those of quinia. According to some authorities, two different substances have been described as quinidia. One of them, to which the name of quinidia should be restricted, is isomeric with quinia, and forms similar salts; the other, *cinchonidia*, is isomeric with cinchonia, and its salts are analogous to the salts of this alkaloid.

Quinoidia or Chinoidine is an amorphous, brownish, resiniform, substance, of very bitter taste. It is procured by exposing the above-mentioned alkaloids, or cinchona itself, to the action of the sun, or is obtained from the mother-waters of sulphate of quinia, by the addition of an alkaline carbonate. It is uncrystallizable, as are also the salts which it forms with acids. It is sometimes sold under the name of *precipitated extract of bark.*

Preparations of Cinchona.

Quinia Sulphas.—*Sulphate of Quinia.*

According to the U. S. Pharmacopœia, this salt is procured by the following process. The bark employed is coarsely powdered, and boiled in water containing muriatic acid, by means of which a soluble muriate of quinia is produced. On the addition of lime, the muriatic acid unites with it, and quinia is precipitated along with a portion of lime and of coloring matter. The precipitate is then digested in boiling alcohol to dissolve the quinia, and separate it from the impurities with which it is associated. The alcoholic solution of quinia is next evaporated until it forms a brown viscid mass, which is dissolved in boiling distilled water acidulated with sulphuric acid. By these means a sulphate of quinia is formed, which crystallizes when the solution cools. Carbonate of lime, in the form of unpurified boneblack, is, however, previously added, to neutralize the free sulphuric acid and decolorize the solution. The latter purpose is perfected by a second crystallization.

The salt procured in the manner above described is now regarded as a neutral sulphate, composed of one equivalent of the acid and one of the base. It is a crystalline salt, its crystals being very delicate, white, shining, flexible, and acicular. It is inodorous, but intensely bitter. On exposure to the air, the crystals effloresce slightly. At a temperature of 212° F., and with moderate friction,

they become phosphorescent; at a somewhat higher temperature they coalesce, forming a tenacious mass, and at a red heat are decomposed without residue. Sulphate of quinia dissolves readily in thirty parts of hot, and in 740 parts of cold water, giving the solution in the former case a bluish tinge. It is perfectly soluble in alcohol, and but very slightly so in sulphuric ether.

Several other salts of quinia have been procured, and are occasionally used in medicine, but most of them possess no advantage over the sulphate. The principal are: the *muriate*,[1] *nitrate*, *acetate*, *citrate*, *tartrate*, *phosphate*, *tannate*, *hydrocyanate*, *ferrocyanate*, *and lactate.*

SULPHATE OF QUINIDIA.

This salt is distinguishable from sulphate of quinia by its greater solubility in water and alcohol; its composition is the same as that of the latter preparation.

CINCHONIÆ SULPHAS.—*Sulphate of Cinchonia.*

The sulphate of cinchonia is a crystalline solid. It contains about 84 per cent. of cinchonia. It is more soluble than the sulphate of quinia, requiring only 54 parts of cold and a less proportion of hot water for its solution. It is soluble in alcohol, and is rather less bitter than the sulphate of quinia.

QUINIÆ VALERIANAS.—*Valerianate of Quinia.*

It is obtained by dissolving freshly precipitated quinia in diluted valerianic acid. It forms transparent or white rhomboidal crystals, and exhales the peculiar, penetrating, and offensive odor of valerian. Its taste is acrid and bitter.

DECOCTUM CINCHONÆ FLAVÆ.—*Decoction of Yellow Cinchona.*

A troyounce of bruised yellow bark is boiled in a pint of water for fifteen minutes in a covered vessel, the liquor strained while hot, and sufficient water added through the strainer to make the decoction measure a pint. It is usually recommended to add lemon-juice or a little sulphuric or muriatic acid to the menstruum before boiling. In appropriate cases wine may be used for this purpose instead of water, and in either case a little bruised orange peel improves the flavor of the decoction.

DECOCTUM CINCHONÆ RUBRÆ.—*Decoction of Red Cinchona.*

This decoction is prepared in the same manner as that of yellow bark.

INFUSUM CINCHONÆ FLAVÆ.—*Infusion of Yellow Cinchona.*

Having moistened a troyounce of the finely-powdered bark thoroughly with water acidulated with aromatic sulphuric acid, introduce it into a glass percolator, press it firmly, and pour water upon its surface so as to keep it covered. So long as the liquid passes turbid, return it into the apparatus; then allow the filtration to continue until a pint of clear infusion is obtained.

[1] The sulphate of quinia is soluble in 800, the muriate in 60 parts of water of medium temperature. The acid in the latter would seem to render it more favorable in its action upon and in the stomach than the sulphuric acid of the sulphate.

INFUSUM CINCHONÆ RUBRÆ.—*Infusion of Red Cinchona.*

This infusion is prepared in the same manner as the previous one. In both cases wine may be used as a menstruum instead of water.

EXTRACTUM CINCHONÆ.—*Extract of Cinchona.*

"Take of yellow Cinchona in fine powder, twelve troyounces; Alcohol three pints; Water a sufficient quantity. Mix the powder with twenty fluidounces of the alcohol, and allow the mixture to stand for four days; then introduce it into a conical glass percolator, and gradually pour upon it the remainder of the alcohol. When the liquid ceases to pass, pour upon the residue sufficient water to keep its surface covered, until three pints of tincture have passed. Set this portion aside and continue the percolation until six pints of infusion are obtained. Distil off the alcohol from the tincture, and evaporate the infusion until the liquids respectively are brought to the consistence of thin honey; then mix them, and, by means of a water-bath, evaporate to the proper consistence."

EXTRACTUM CINCHONÆ FLUIDUM.—*Fluid Extract of Cinchona.*

This preparation is made by exhausting yellow cinchona in a percolator by means of alcohol, glycerin, and water.

TINCTURA CINCHONÆ.—*Tincture of Cinchona.*

Take Yellow Cinchona, in powder, six troyounces; Water and Alcohol, of each a sufficient quantity, and obtain by percolation two pints of tincture.

TINCTURA CINCHONÆ COMPOSITA.—*Compound Tincture of Cinchona; Huxham's Tincture of Bark.*

Take of Red Cinchona, four troyounces; Bitter Orange Peel, three troyounces; Serpentaria, three hundred and sixty grains; having introduced them in the form of powder moistened with diluted alcohol and packed them in a glass percolator, gradually pour upon them diluted alcohol until two pints and a half of tincture are obtained.

History.—The introduction of cinchona into European practice as a medicine was singularly slow, and embarrassed by great impediments. Its virtues seem to have been familiar to the Spaniards in Peru, after the conquest of that country, and as early as the year 1600, but it acquired no settled reputation for nearly a century later. It is even stated by Condamine, that, in 1735, the natives of the province of Loxa, whence the best varieties of the bark were procured, attached but little value to it as a medicine. After the lapse of still another century, Humboldt made a similar remark, and even quite recently, in 1848, Delondre found the Indians who were engaged in gathering the bark careless about taking it, although they were nearly all deeply affected with malarial cachexia. This indifference, however, is not inconsistent with the fact stated by other travellers, that the bark is highly esteemed by those of the natives who suffer from periodical fever at some distance from the sources of its infection.

Peruvian bark appears to have been first carried to Europe in

1632. But according to Villarobel, it had been seven years in the possession of the Spaniards before any trial was made of its virtues. A certain ecclesiastic of Alcala is said to have been the first person in Spain to whom it was administered. This was in the year 1639. It, however, became more generally known through the Count of Cinchon, Viceroy of Peru, whose wife had been cured by it of intermittent fever. On his return to Europe about 1640, he carried with him a quantity of the medicine, and distributed it to the poor. Owing to the circumstance which led to its importation it was called the "Countess' powder." Yet the indifference or the hostility of the Spanish physicians towards it, as a new remedy, prevented its general use, nor was so great a boon to suffering humanity accepted by the reluctant Faculty until public sentiment in its favor was determined by an authoritative decision of the head of the Catholic Church. In 1843, a Spanish Jesuit, Juan de Logo, was ordered by Pope Innocent X. to examine the bark, and on the favorable report of his Holiness' chief physician, it was declared to be not only innocent, but most salutary. In 1649 or 1650, Brunacci, the Provincial of the Jesuits, brought a large quantity of it with him from America, and, a great council of the order being held at the time, a good opportunity occurred of sending it to all parts of Europe by the brethren on their return to their homes. From these circumstances it acquired the name of *Jesuits' bark or powder*.

The history of the introduction of Peruvian bark into medical practice forms a sad commentary upon the blindness and perversity of human nature. Religious and scholastic prejudices conspired to reject and contemn one of the most valuable discoveries recorded in the history of medicine. Protestant bigotry refused to admit that a powder introduced by the Jesuits, and called after them, could possibly possess any salutary virtues, and the Galenical schools would not believe that a medicine could cure unless its operation were explicable according to their established dogmas. These fanatics went so far as to attribute the ordinary constitutional results of malarial poisoning to the new remedy, as the vulgar of the present day are prone to do.

For many years the bark was sold at a very high price, which prevented its virtues from being completely known, or a proper method adopted for its administration. On this account many physicians abandoned it as an uncertain remedy for intermittent fever, and also because it did not afford security against a return of the paroxysms. In England it appears to have been used pretty extensively after the year 1660. Yet for twenty years subsequent to this date, its virtues were imperfectly acknowledged. In 1662, Guy Patin declared that cinchona does not cure intermittent fever, and that he had abandoned its use. Even in 1682, Sydenham spoke of it without enthusiasm, although not doubtingly. Twenty years later still, Torti felt himself obliged to reiterate the assertion that it is a most innocent remedy. It is not, he exclaims indignantly, either venomous or narcotic; it does not inspissate the humors, nor

cause jaundice, dropsy, or apoplexy, nor aggravate the fevers it is alleged to cure; it is not that sortilegious and diabolical medicine which the scribblers and physicians of the seventeenth century represented it to be; and he calls Morton and Sydenham to witness with himself that it was never known to injure any one.[1] The real appreciation of the value of cinchona bark as a remedy for intermittent fever, must be attributed to an Englishman, Talbor by name. He was an apothecary of Cambridge, but removed to London about the year 1670. He professed to have a very successful method of administering the bark, but he kept it a secret. The jealousy excited in the College of Physicians by his success obliged him to seek the protection of the Court, and the King actually issued a mandate to the College forbidding them to molest or disturb him in his practice. After having become famous in England, he was sent for to France, where he was so fortunate as to cure Condé, Colbert, and the Dauphin. Louis XIV. purchased his secret for 2000 louis d'or, and an annual pension of 2000 livres, besides conferring upon him a patent of nobility and a ten years' monopoly of his remedy. For a time the bark was sold at exorbitant prices, a single dose costing a louis d'or. Thus, as Sir George Baker remarks, in recording the principal events in this narrative:[2] "Had it not been for the casual experience of an uncivilized people, it might never have been discovered that there existed in the stores of nature a specific febrifuge. Had not the influence of a great religious society, unconnected with the practice of physic, counteracted prevailing prejudices, at an early period, this medicine, though brought into Europe, might have long remained in obscurity, unknown, and useless. And lastly, had not physicians been taught by a man whom they, both abroad and at home, villified as an ignorant empiric, we might at this day have had a powerful instrument in our hands, without knowing how to use it in the most effectual manner."

In the middle of the last century Peruvian bark began to be prescribed in continued fevers of a low type, and acquired the character of a standard remedy in these affections upon the recommendation of Huxham, Pringle, Fordyce, and Cullen. Haygarth, Fothergill, and Heberden employed it in gout and rheumatism towards the close of the same century.

The discovery of the active principles of cinchona, imperfectly made, in 1803, by Duncan, of Edinburgh, was perfected by Pelletier and Caventou, in 1820, as far as regards quinia and cinchonia. In 1833, Henry and Delondre announced the existence of quinidia, whose true characters were more fully determined by M. Pasture, in 1852. The introduction of the two former alkaloids into practice, which dates from 1820 and 1821, is due to MM. Double, Magendie, Chomel, and Villermé, in France, and to Drs. Elliotson, Dickson, and Barker, in England. By whom or when quinia was

[1] Therapeuticé Specialis, Lettere a Muratori.
[2] Med. Trans. of the College of Physicians in London, iii. 173.

introduced into the United States, it is impossible to say, since the leading medical journals from 1825 to 1830 contain little respecting the medicine that is not borrowed from European sources.

Within a few years the range of medical experiment with quinia and the other alkaloids and constituents of cinchona has been greatly extended by the labors of Jacquot, Monneret, Rilliet, and Barthez, and especially by M. Briquet, whose work on the curative action of cinchona and its preparations is a monument of singular industry and well directed zeal.[1]

Action. *On Animals.*—The experiments which were at first performed to determine the medical properties of cinchona, consisted in applying a decoction of this substance to the various solids and liquids of the economy. The tannin of the decoction produced its usual physical result, coagulation of albumen, and this was tortured into various shapes in support of many different hypotheses. But no practical result was obtained. We must come down to a period subsequent to that of the discovery of quinia, for more precise notions on the subject. From experiments performed in 1829, Desiderio inferred that sulphate of quinia acts upon rabbits as a stimulant, and that its effects are heightened by alcohol and opium, but diminished by cherry-laurel water, digitalis, and bloodletting. But Giacomini, who repeated these experiments in 1840, came to a directly opposite conclusion. In truth the effects observed by both experimenters were the same; but Giacomini, regarding the secondary phenomena alone, perceived in them the effects of sedation, while Desiderio, finding venesection an efficient remedy for the primary symptoms, concluded them to be the result of stimulation.[2] The symptoms actually witnessed were general muscular debility, and a condition resembling intoxication; in fact they closely resembled those which are produced in man by very large doses of quinia. In the experiments performed by Magendie, and also by Mélier,[3] sulphate of quinia, given to dogs in half drachm doses, acted poisonously, and was rejected from the stomach unless the œsophagus were tied. When this precaution was taken, however, death occurred in the course of about twenty-four hours, and was preceded by the following symptoms: retching, agitation, trembling, and an unsteady gait, with a drooping and feeble aspect. The pupils were dilated, the pulse frequent (120), and coma, with muscular spasms, and labored, stertorous breathing, preceded death. On dissection, the lungs were found engorged with blood, the vessels of the brain, and also of the stomach, were congested, and the blood contained in them was liquid, or else formed a soft, gelatinous clot, and the serum was turbid and discolored. Similar effects were observed by Dr. Baldwin, in some experiments performed by him.[4]

[1] Traité Thérapeutique du Quinquina et de ses préparations, 2ème éd. Paris, 1855.

[2] Académie des Sciences, Oct. 1829; Revue Méd., xcvi. 368.

[3] Mém. de l'Acad., x. 722.

[4] Am. Journ. of Med. Sci., April, 1847.

Comparative Action on Animals and Man.—We shall, in imitation of those who have investigated this subject experimentally, describe the effects of sulphate of quinia and other salts of cinchona upon the different organs, beginning with circulatory apparatus.

On the Circulation.—The experiments on animals performed by Briquet led him to the following conclusions: The sulphate of quinia injected into the veins in sufficient quantity suspends at once the action of the heart, causing death by syncope and destruction of the heart's contractility; and when this result does not ensue, the movements of the heart continue for several days to be slow and feeble.[1] A more precise analysis of this action is furnished by Eulenberg in his experiments upon frogs.[2] On injecting quinia under the skin of frogs the movements of the heart diminished in force and frequency, and the respiration, after growing irregular and feeble, ceased. But the heart pulsated for some time after breathing was suspended. Hence, the experimenter inferred that the poisonous action was exerted, not through the vagi, but directly upon the heart and ganglionic system.

In small doses cinchona and its preparations increase the frequency of the pulse, but in large doses appear to act sedatively upon the circulation. Thus Giacomini took from forty to fifty grains of sulphate of quinia during the night, and found that his pulse fell as much as twelve beats in a minute. This result was furnished by a series of experiments which lasted forty-seven days. But no account seems to have been taken of the natural subsidence of the pulse in the night-time. The experiments of Favier, if accurate, are more to the purpose. Under the influence of about twelve grains a day his pulse fell from the normal rate to 57 and then to 50 beats a minute, and when four times this dose was taken the pulse fell to 45 and 40, and became thready. Dr. Mendenhall, of Cincinnati, on different occasions took two, five, ten, and twenty-grain doses of sulphate of quinia, but the last-named dose alone had any sensible effect upon the pulse, increasing its frequency slightly.[3] In those diseases to which it is particularly applicable, viz., periodical fevers, sulphate of quinia undoubtedly reduces the frequency of the pulse, partly by its direct sedative action, but partly, also, it may be presumed, by neutralizing or removing the cause of vascular excitement. In many cases, the pulsations fall so far below the normal rate as to leave no doubt that they are affected by the medicine. M. Legroux found this sedative influence strikingly evident in acute rheumatism, the pulse falling daily by as much as ten beats, and at the same time becoming small, and sometimes intermittent.[4] Drs. Hunt and Mackie, of N. O., reached similar results in experiments performed by them on convalescents from various

[1] Dr. Baldwin, of Montgomery, Ala., in his experiments upon dogs, found the frequency of the pulse *increased.* It is probable that the alarm of the animals more than counteracted the sedative action of the quinia upon the heart.

[2] Archives Gén., 6ème sér., ix. 494.

[3] Am. Journ. of Med. Sci., July, 1846, p. 79.

[4] Journ. de Méd., iii. 109.

diseases in 1845.[1] M. Briquet, who cites numerous observers in proof of the sedative action of quinia, also performed many experiments of his own, and appears to be warranted in drawing the following conclusions: 1. Sulphate of quinia *in large doses* moderates the frequency of the pulse, and sustains its influence for several days after the administration of the medicine has ceased. 2. This action is proportioned to the existing frequency of the pulse, and the largeness of the dose of the medicine, but it is never observed when less than fifteen grains are administered at once. 3. An intercurrent inflammation may neutralize this sedative operation. 4. The pulse is diminished in force as well as frequency. 5. The dose required to produce this effect occasions such a disturbance of the system as to render its administration improper, unless the disease, by its duration, severity, or the dangers it involves, exposes the patient to still greater risk. It follows from the above observations and experiments that quinia, at least in full doses, tends to lessen the animal temperature. Yet Gell and Ringer, in some observations on persons in a non-febrile condition, found the effect quite inconsiderable;[2] and Lewizky, on injecting a solution of quinia into the jugular veins of rabbits, found, indeed, that the temperature fell, but that it did so when sulphuric acid, or even cold water, was introduced in the same manner. He ascribes the diminished temperature which undoubtedly follows the administration of full doses of quinia in many febrile disorders, to a sedative action of the drug upon the heart through the spinal and sympathetic nervous systems.[3] The only observations upon the influence of *cinchonia* on the pulse which we have met with are those of Dr. D. B. Elson,[4] in which while 10 and even 20 grains of sulphate of quinia did not lower the pulse rate, even when ten such doses were taken at intervals of half an hour, a slight *increase* of the rate under similar doses of cinchonia was noted. The latter can therefore hardly be accepted as a physiological effect.

The influence of the salts of cinchona *on the blood itself* is variously appreciated by different observers. Bonora and Arvedi state that when sulphate of quinia is administered to horses in large doses, the blood drawn loses the power of coagulating which it previously possessed.[5] So Mélier, Monneret, and Magendie observed that when sulphate of quinia is given to animals, or is taken by man in poisonous doses, it appears to lessen the coagulability of the blood. M. Legroux, in the few analyses of the blood made by him in cases of acute articular rheumatism treated by quinia, found the proportion of fibrin diminished, and that of the red globules increased. Briquet, on the other hand, maintains that, whether the medicine is received into the stomach or injected into the veins, it equally augments the proportion of fibrin in the blood, and diminishes that of the red globules. These different, and indeed

[1] N. O. Med. and Surg. Journ. and Bulletin of Med. Sci., iv. 19.
[2] Lancet, Oct. 1868, p. 564.
[3] Virchow's Archiv, xlvii. 352.
[4] Am. Journ. of Med. Sci., July, 1866, p. 97.
[5] Mélier, loc. cit.

opposite results, do not at present appear to be reconcilable. If we examine the effects of excessive doses of the medicine as given below, we shall find that signs of an alteration of the blood are not included among them, not even when death is the result. The experiments of Binz, Kerner, Stricker, and others appeared to show that quinia mixed with living blood exerts an inhibitory power upon the movements of its white corpuscles. But Geltowsky inferred from his own experiments that, however this may be under the microscope, there is no proof that quinia exerts such a power within the bloodvessels.[1] Moreover it is admitted by Binz himself that in cases of septicæmia, in which the alleged operation of the drug would be the most important, it would be necessary to administer it in doses of three or four drachms a day, and that at not very long intervals. Whence it would appear that the scientific view of the operation of the medicine is hardly compatible with its practical application. It seems probable, therefore, that, in the cases we are about to notice, some special conditions of the system must have existed. Mr. Vipan has published four cases of different diseases, none of them of a scorbutic or malignant character, in which doses of three grains of sulphate of quinia, given three times a day for several days, were followed by the appearance of purpurous spots upon the skin. In one case the liquid contained in a blister was deeply colored with blood.[2]

On the Nervous System.—When the salts of cinchona, in large doses, are administered to *animals* by the stomach or otherwise, they derange, enfeeble, and finally extinguish nervous action, after having at first occasioned a certain degree of excitement, attributable perhaps to the local irritation of the salt employed. Afterwards the animal staggers, becomes agitated, and sometimes convulsed, and then assumes a dull, inanimate expression, and subsides into a state of apparent debility and torpor, with impaired vision and widely-dilated pupils. In all such experiments, the only lesion found after death is increased vascularity of the membranes of the brain.

When five or six grains of sulphate of quinia are taken by an adult man at a single dose, or two or three times that quantity in the course of twelve hours, some heaviness and confusion of thought are usually experienced; there is occasionally headache, and frequently buzzing in the ears, vertigo, and unsteadiness of gait. The noises in the ears are various, and are compared to the ringing of bells, the striking of a clock, the rushing, roaring sound of water or of steam. When the doses are larger, or are repeated more frequently, a sense of fulness, tension, and pulsation is experienced in the head; the face becomes suffused and animated, the eye is bright, epistaxis sometimes occurs, the patient is restless and agitated, and complains of muscular twitching in the limbs. These phenomena are of several hours' duration, and are succeeded by some exhaustion, and an inclination to sleep, with slight torpor and muscular

[1] Practitioner, viii. 321. [2] Lancet, July, 1865, p. 37.

debility. If as much as thirty grains are given daily, in divided doses, for several successive days, there may be observed very great depression, apathy, and somnolence, a very unsteady gait, hardness of hearing, dimness of vision, and dilatation of the pupils; the general sensibility is very obtuse, the muscular movements are feeble and the limbs tremulous. If, finally, the dose have been excessive, complete loss of consciousness may occur, sight and hearing may entirely fail, the skin may lose its sensibility, and the limbs their power of motion.

Some of these symptoms may be more particularly noticed. *Headache* seldom becomes so severe as to imply danger; indeed, in some cases, as in typhoid fever, this symptom has appeared to be relieved by quinia. The *deafness*, although sometimes very great, and even complete, is alleged never to be permanent; but this rule is not absolute, as will hereafter be shown, at least in regard to excessive or long-continued doses of the medicine. *Tinnitus aurium* usually subsides in a few days at furthest. The *eye* is morbidly sensitive, and experiences a feeling of tension, vision is subsequently clouded, objects appear double or unnaturally small, and finally very large doses may produce blindness. In that case the pupils are largely dilated. This amaurosis seldom lasts longer than a day or two, but Briquet mentions a case in which it did not cease for a month. *Giddiness* and *buzzing in the ears* are among the most usual effects of the medicine, but the confusion of sight and faintness which accompany them cease as soon as the patient lies down. They are apt, however, to recur for several days whenever the erect posture is assumed. In the higher degrees of cinchonism, the patient sometimes *reels* as if intoxicated, and presents the appearance characteristic of the invasion of low fevers. In a few cases of nervous and excitable persons, *delirium* has been observed, sometimes of a gay or noisy description, like the excitement produced by alcohol,[1] but less frequently it accompanies a dreamy, dull, and listless condition. In a few instances, also, *convulsions* have occurred, either when the dose was too large, or when it was given to a person affected with cerebral disease. Finally, when an overdose is taken, as in the cases cited below, a state of debility may ensue which gradually deepens into *collapse*.

Dr. Hinkle ascribes to cinchonia the production in children under twelve years of age of "a peculiar erythematic hue of the skin which confined itself to the face, thorax, and upper extremities, and continued from one to two hours, while the patient was under its full influence." We too have been informed of cases in which any salt of cinchona occasioned an eruption of urticaria. Dr. H. pronounces cinchonia to be less nauseous, and more acceptable to the stomach than quinia, and that it does not produce fulness of

[1] A very interesting case is related by Dr. Baldwin of a man affected with quotidian remittent fever, who took about 36 grains of sulphate of quinia at a dose. The effect was exhilarating. The patient was in a fine humor, talking incessantly, and laughing, and insisting on the reality of events which were purely imaginary.—*Am. Journ. of Med. Sci.*, April, 1847, p. 308.

the head or headache, tinnitus aurium, or deafness. The same virtues are attributed to it by Dr. Porcher. M. Bouchardat also alleges that it is less liable to produce tinnitus and visual disorders than quinia, but that in smaller doses and more frequently it occasions a peculiar and pretty severe tensive pain in the forehead. In doses of twelve or fifteen grains it is much more apt than quinia, he remarks, to cause præcordial pain, subsultus, and faintness, even to syncope. All of these symptoms were noted by Moutard-Martin in experiments upon himself and as effects of the medicine upon his patients. They displayed themselves shortly after it was taken, and continued for half or three-quarters of an hour.

On the Respiratory Organs.—In Mélier's experiments upon animals poisoned with sulphate of quinia, their lungs were found to be engorged, but M. Briquet insists that this condition resulted from the protracted agony of the animals, already exhausted by other experiments, and that when death takes place from the sulphate of quinia alone, the lungs are quite as often pale as engorged. The same want of uniformity exists in the pulmonary lesions found in man in fatal cases of poisoning by this salt. That the lungs are, however, embarrassed in their functions, but probably through the nervous more than the circulatory system, is proved by observation. It is not unusual for persons under the use of large doses of the medicine to complain of tightness and oppression of the præcordia, while the face grows pale and wears a look of distress. Sometimes, indeed, there is severe dyspnœa, and a sibilant rhonchus is heard in the lungs. Yet there is no reason to believe that this interference with respiration predisposes the lungs to become engorged or inflamed.

On the Digestive Organs.—Cinchona and its preparations have always ranked among the most efficient of stomachic medicines. Its salts have less energy in this respect than the bark itself; yet they are generally employed, and sometimes with evident advantage, to strengthen the digestion and quicken the appetite. In large doses, however, they manifestly derange the stomach, causing a sense of oppression and even pain in this organ; at the same time there may be dryness and bitterness of the mouth, and a foul and pasty tongue, which sometimes, on the other hand, becomes dry and brown in the centre, while its edges are red and shining. Not unfrequently, also, nausea and vomiting occur when the doses are too often repeated; and if the administration is still persisted in, all the symptoms of gastric inflammation may arise. Analogous effects are produced in the intestinal canal. Small doses have a decided tendency to produce constipation, while large quantities very generally occasion diarrhœa. There are persons, however, who experience colic with diarrhœa even from very small doses of sulphate of quinia. In such cases the administration of the medicine should be guarded by opium.

It has been asserted that bark influences the size of the spleen, causing it to contract by a direct agency when it is enlarged. This action may possibly be of a secondary nature. The bark, by curing

the disease which maintains the spleen in an enlarged condition, induces the contraction of the organ in the same way as it favors the restoration of all the impaired functions. Certain experiments of Valleix upon cases of ague with enlarged spleen, appear to show that quinia has no direct influence in lessening the size of this organ.[1] But these results do not coincide perfectly with those obtained by Dr. Smith of Madras, and which the reader will find in a subsequent portion of this article.

On the Genito-urinary Organs.—The elimination of the salts of cinchona with the urine exposes these organs to irritation. If the urinary tract be anywhere the seat of disease, it is apt to be aggravated by these medicines. This effect is frequently observed in gonorrhœa. Sometimes, independently of such a cause, the patient is affected with irritation about the neck of the bladder, with hæmaturia, or with retention of urine.[2] Dr. Cachère[3] relates two cases which illustrate this mode of action. In one of them "profuse hemorrhage" took place from the urinary passages in a boy of thirteen who took ten grains of quinia in three doses. Subsequently an infusion of cinchona produced the same effect. In the case of a girl of seven, quinia, administered in different ways, invariably occasioned a like result.

Some persons have attributed to quinia an *emmenagogue operation.* Petitjean affirms that he so frequently saw abortion produced during the exhibition of quinia in intermittent fever that he ceased to prescribe it for pregnant women.[4] The statement is opposed by the experience of Rodrigues,[5] and Henry attributes this supposed effect of quinia to the disorder of the general health and the mechanism of the paroxysm in malarial fevers.[6] Dr. Rich, of Ga., ascribes to the medicine the power of arresting menorrhagia occurring along with obscure intermittent phenomena; but he associated it with direct styptics. He also attributes to it the suspension of contractions of the uterus threatening abortion under similar circumstances,[7] and, no doubt correctly, so far as it neutralizes the disturbing malarious element. It has also been alleged that, on the other hand, it renders uterine contractions more active during labor. So Monteverdi declares it to be superior even to ergot of rye for this purpose, being more rapid in its action, "and also being harmless both to mother and child." He prescribes three or four grains every hour for several hours.[8] These statements are hardly consistent with one another, nor with the further assertion that it is an efficient means of overcoming rigidity of the os uteri.[9] The assertions of Monteverdi have been put to the test by numerous practitioners, and been found entirely unsupported by experience. Physicians living in malarial regions where quinia

[1] Lancet, Sept. 4th, 1847
[2] Dassit, Bull. de Thérap., xv. 248.
[3] N. Orleans Journ. of Med., Oct. 1869.
[4] Braithwaite's Retros., 1846, ii. 222.
[5] Ib., iv. 263
[6] Bost. Med. and Surg. Journ., 1854.
[7] Charleston Journ., xv. 179.
[8] Brit. and For. Med.-Chir. Rev., April, 1872, p. 540.
[9] Bull. de Thérap., lxii. 180.

is constantly and largely employed, testify that it in no manner influences either the course of gestation or the phenomena of labor.[1] Possibly, when large doses of the medicine are given to females, the irritation produced by it in the bladder may be propagated to the uterus, occasioning good or evil effects according to the existing condition of that organ. But evidence upon this point is still wanting.

On the Skin.—Allusion has already been made to the cutaneous eruptions which sometimes follow the administration of quinia. Dr. Garraway reports the case of a lady in which quinia occasioned suddenly œdema of the face and limbs, an erythematous rash, and uneasiness in the præcordia, with subsequent exfoliation of the cuticle. Other analogous examples are published by Dr. Hemming and Dr. Thorowgood.[2]

Local Action.—When a salt of quinia is applied to the denuded cutis it occasions severe burning and smarting pain, and sometimes forms a superficial eschar. Trousseau refers to two cases in which an eschar of half a line in thickness was produced. M. Briquet relates that a female patient of his, for whom he prescribed baths to be taken at intervals of several days, each of them containing about half an ounce of sulphate of quinia, experienced a prickling and smarting sensation in the skin during the bath, and after leaving it her body was covered with red spots, which were succeeded by an eruption of acute lichen.

Poisonous Effects.—The earlier historians of cinchona did not fail to notice that ill effects occasionally arise from its use, such as gastric derangement, colic, diarrhœa, headache, restlessness, sleeplessness, and deafness; but these symptoms were always temporary, and seldom reached so high a degree as to excite alarm. But after the discovery of quinia, which contained in a small bulk the principal powers of the medicine, cases occurred which were distinguished by very alarming symptoms, such as delirium, coma, blindness, deafness, gastralgia, epileptiform convulsions, dyspnœa, aphonia, paralysis, congestion of the lungs, and hæmaturia. Trousseau speaks of a young woman who was delirious for a whole day after taking twenty grains of sulphate of quinia. In another case, that of a male, forty-six grains rendered the patient blind, deaf, and delirious, and so giddy as to be unable to walk. He also vomited continually. A case is reported by Gélinau of a delicate and nervous lady who, after taking ten grains of sulphate of quinia on an empty stomach, was attacked in about two hours with violent abdominal pains, rigors, and general prostration with cold sweats. The face was pale, the eyes sunken, the pupils dilated, the teeth clenched, and the limbs stiff; confused answers were given to questions; the respiration was calm, the pulse 60. In about an hour the pulse rose to 80; there were ringing and buzzing noises in the ears, and the catamenia, which were not then due, made their appearance.

[1] Compare Am. Journ. of Med. Sci., July, 1872, pp. 73, 287, 290; Ibid., Oct. 1872, p. 438.

[2] Brit. Med. Journ., Oct., Nov., and Dec. 1869.

The next day the patient was as well as usual, except that she suffered from dulness in the head, and heaviness of the limbs.[1] Giacomini reports the case of a man of middle age who took, by mistake, about three drachms of sulphate of quinia at a single dose. He gradually became giddy and feeble and then insensible. Nine hours after taking the medicine he lay motionless and pallid, the fingers were bluish and cold, and the whole surface cool, the respiration slow and suspirious, the pulse regular, but slow and hardly perceptible, the pupils widely dilated, the sight and hearing almost extinct, and the voice extremely feeble; the thirst was great, the tongue pale and moist, and the breath cold. The patient could not leave his bed until the fifth day.[2] A similar case is narrated by Dr. Baldwin, in which sixty-eight grains were taken in the course of about twenty hours.[3] A case is also reported of a man who, after taking three doses of sulphate of quinia, each of eight grains, and at intervals of four hours, experienced the usual phenomena of cinchonism, then became drowsy, and afterwards, by degrees, hemiplegic. He did not recover the use of his limbs.[4] Graefe, of Berlin, met with two cases of amaurosis which he attributed to quinia,[5] and Simon several of hæmoptysis following the administration of this substance to persons affected with intermittent fever.[6]

But the evidences of the poisonous properties of this drug are also furnished by cases in which it proved fatal to life. Four such cases are collected by M. Mélier.[7] In one of these the patient was affected with delirium and coma, and died on the second day. Guersant has given an account of a physician and his wife, both of whom were poisoned by this preparation, the former fatally, after taking nearly five ounces of sulphate of quinia within the space of eight or nine days. The symptoms were such as have been detailed in the case of Giacomini.[8] Dr. Baldwin has reported the case of a child, six years of age, who died from taking eight grains of this salt, in two doses, with an interval of three hours between them, and with symptoms like those already described.[9] Whenever, in such cases, the body has been examined after death, similar lesions have been found as upon dissection of animals destroyed by the same cause, viz., congestion of the lungs and brain, and in some degree also of the stomach.

A fatal effect, it has just been stated, may follow the administration of comparatively small quantities of quinia. Such doses, when continued, have occasionally produced toxical, but less serious consequences. Dr. Van Buren saw partial loss of hearing result from taking two grain doses of quinia for a period of two weeks, and a case of amblyopia of three weeks' duration, and quite intractable, follow the use of four grain doses every four hours for a week.[10]

[1] Bull. de Thérap., lxiii. 234.
[2] Mémoires de l'Acad. de Méd., x. 731.
[3] Am. Journ. of Med. Sci., April, 1847, p. 295.
[4] Western Lancet, xviii. 175.
[5] Bull. de Thérap., lv. 141.
[6] Ibid., lx. 140.
[7] Mémoires de l'Acad. de Méd., x. 733.
[8] Dict. de Méd., 2ème éd., xxvi 569.
[9] Am. Journ. of Med. Sci., April, 1847, p. 293.
[10] N. Y. Journ. of Med., vi. 81.

But in some cases, it should be borne in mind, enormous doses have been taken without fatal or even alarming consequences. In the case of the lady related by Guersant, and referred to above, about 600 grains were used within the space of a few hours. Banquier states that one of his patients took seventy-two grains of sulphate of quinia by mistake, and without hurt; and Tomasi di Spineto asserts that ninety grains may be given several times a day without danger.[1] Dr. Taussig, of Rome, Italy, reports the case of a soldier who swallowed an ounce of the best sulphate of quinia at a single dose. Except complete deafness, and a kind of stupor, which were temporary, no remarkable effects were produced.[2] Dietl treated a woman with epilepsy by means of quinia in doses which gradually reached 120 grains a day; no evil effects occurred, and the patient was cured of her disease.[3] "A medical friend in Alabama," says Dr. Dickson, "assures us that he had administered thirty grains of the solution of quinine every hour for seventeen successive hours; and we have heard authentically of a Western physician, who emptied into the stomach of a patient laboring under bilious remittent, an ounce bottle of sulphate of quinine in one night. From thirty to fifty grains are now spoken of as not unfamiliar doses, and even one hundred grains are occasionally given at once, and, we are assured, both with safety and striking success."[4] Dr. Drake mentions a man at Memphis, Tenn., who took eighty grains of quinia at a single dose, and another at Montgomery, Ala., who consumed an ounce in the course of three days, and recovered. At Plaquemine, La., an old lady used ten grains every two hours, until an ounce had been taken. No bad effects followed.[5] It must not be forgotten that sulphate of quinia is often largely adulterated. This fact may help to explain the innocuousness of the medicine in some of the many cases resembling the above, which are said to be of frequent occurrence in the western and southern portions of the United States.

Mode of Action of Cinchona and its Salts.—That the active principles of cinchona may undergo absorption by the sound skin, can hardly be doubted, when it is remembered how often intermittent fever has been cured by bark jackets, baths, etc. The results immediately to be noticed merely prove that the salts of cinchona are not so absorbed in sufficient quantity to be detected in the urine. Martin Solon concluded, from a number of experiments instituted by himself, that sulphate of quinia is not absorbed by the skin, even when denuded of its epidermis.[6] But other writers, and among them Mitscherlich,[7] state unequivocally that it is absorbed in the latter case. While the cuticle remains unbroken it is pro-

[1] Mitscherlich, Lehrbuch, i. 295.
[2] Times and Gazette, April, 1864, p. 461.
[3] C. Binz, Untersuchungen, etc., p. 60.
[4] South. Journ. of Med. and Pharm., i. 9.
[5] Diseases of the Interior Valley of North America, i. 777.
[6] Bull. de Thérap., xxvii. 466.
[7] Op. cit., i. 294.

bable that a comparatively trifling degree of absorption takes place. The carefully conducted experiments referred to by Briquet, and those performed by himself, show that, however applied to the sound skin, sulphate of quinia cannot be detected in the urine. It is, however, absorbed by the denuded cutis in small quantities. If applied in substance it causes severe pain, as already stated; but dissolved in water, or incorporated with simple ointment, the application is less severe.

This salt is readily absorbed by the mucous membranes, and is found substantially in the blood, which dissolves it much more readily than water. It has been detected also in the saliva, the bronchial mucus, the tears, and milk, and in the serum of dropsical effusions. It is eliminated very slightly with the perspiration and the fæces. On the other hand, Thau[1] found that in healthy persons all of the quinia ingested, save four per cent., could be recovered from the urine, and that in typhoid fever the result was substantially the same. He observed, further, that in health the diminution was most active during the first six hours, and terminated within twelve hours, but that in fever a larger proportion of the medicine was eliminated in the second than in the first period. These results agree with those previously obtained by Dietl, who states that the urine of healthy persons becomes more rapidly charged with quinia than that of diseased persons, and the urine of the young than that of the old. In disease, also, he states that it frequently does not show its presence in the urinary secretion for several days; and, on the other hand, that it continues to be eliminated for some days after its use has been suspended.[2] According to Ranke, the sulphate of quinia diminishes the quantity of uric acid in the urine.[3] Rabuteau did not find that it diminished the excretion of urea.[4]

The experiments of M. Briquet led him to conclude that the constitutional influence of a full dose of sulphate of quinia (15 grains) begins to be manifested within a quarter of an hour after it is taken, and that of a dose of six grains, in about an hour; also, that sensible effects are rarely observed when the dose is less than four grains. Hence, it is evident that whenever a prompt and decided effect is required, the dose must be large. The salts of the other alkaloids of cinchona are subject to the same law. The duration of the symptoms to which they give rise is proportioned to their dose. When six or eight grains of sulphate of quinia are taken at once, their sensible action upon the nervous system ceases in the course of two or three hours, while that of fifteen grains lasts from three to five hours. When twelve or fifteen grains are taken in divided doses, during as many hours, their influence is sustained for eight or ten hours after the last dose; and when the doses are augmented, the effects are proportionately prolonged. If, however,

[1] Practitioner, iii. 60. [2] CANSTATT's Jahresbericht., 1854, p. 154.
[3] Times and Gaz., May, 1857, p. 547.
[4] Bull. de Thérap., lxxv. 475.

decidedly morbid symptoms arise, such as giddiness, deafness, etc., they may be of much greater duration.

Circumstances modifying the Operation of the Salts of Quinia. Age.—According to M. Baudelocque, the functional disturbance caused by these preparations is less decided in children than in adults. He states that even when as much as thirty grains a day of sulphate of quinia are given to children, it occasions neither vomiting, headache, delirium, staggering, colic, nor diarrhœa, and only a slight degree of buzzing in the ears; on the other hand, it displays unusual activity in persons advanced in life, prostrating the strength, disturbing the mind, occasioning ataxic symptoms, deranging the bowels, and irritating the urinary passages. These results are, doubtless, due to the great activity of the absorbent and eliminative functions in early life.

Sex.—In females absorption of the salts of quinia, as shown by their appearance in the urine, is more active than in men, and in accordance with this fact, their influence upon the nervous system is proportionately greater. Especially is the delirium produced by large doses of these medicines most frequent in women. It is estimated by M. Briquet that the dose proper for them is one-fifth less than may be given to men.

Depletion.—M. Briquet infers from his experiments and observations that depletion favors the operation of sulphate of quinia, while diffusible stimulants, such as wine and coffee, diminish and counteract it. Such is also the conclusion of Giacomini from his own experiments.[1] Loss of blood augments the sedation from large doses of the medicine partly by its own influence, and partly by promoting the absorption of the salt.

Antagonism of Opium and Quinia.—M. Briquet is of opinion that opium mitigates the cerebral excitement which is a primary effect of quinia, and, on the other hand, augments the sedation which characterizes the secondary effects of the latter, and hence that a full dose of opium renders a corresponding quantity of quinia less perturbative and more efficient. This combination is very important in acute rheumatism as well as in periodical fevers. Great attention has recently been bestowed on the operation of these two medicines, which seem to be adapted by their antagonism to meet very numerous and important therapeutic indications. In a very interesting paper upon asthenic pneumonia, published by Dr. Gordon, in 1856,[2] the value of quinia in the treatment of the disease is strikingly illustrated, and the statement is subjoined that in the opinion of Dr. Corrigan, its mode of action is to stimulate the capillaries of the lung, *i. e.*, to promote their contraction, and therefore to prevent or overcome the engorgement which forms the physical element of the disease. In 1858, Gubler[3] observed that after taking a full dose of quinia, he experienced tinnitus in the left ear only, and this effect recurred on several occasions. It then occurred to

[1] Annuaire de Thérap., 1843, p. 175, etc.
[2] Dublin Quart. Journ., xliii. 95.
[3] Abeille Méd., xv. 177.

him that he was at the same time suffering from hemicrania of the opposite side, an affection to which he was subject, and he suspected that the vascular congestion of this side might have prevented the toxical effects of the quinia from being developed. If so, he conjectured, the sensation produced by the quinia must be due to an opposite condition, viz., a diminished quantity of blood in the cerebral vessels. Some time afterwards, while treating a case of acute articular rheumatism, for which he had prescribed four grains of extract of opium, and twenty-three grains of sulphate of quinia, he was surprised to find that the appropriate effects of both medicines were entirely wanting. But when the quinia alone was administered, its usual effects were fully developed. From these premises, and from a consideration of the peculiar symptoms produced by quinia and opium respectively, of the fact that while opium causes fulness of the vascular system with a tendency to the skin and an expansive excitement of the brain and the senses, followed by sleep or active delirium, according to the dose, quinia occasions vertigo and tendency to syncope, a stumbling gait, headache, buzzing of the ears, and an indisposition to sleep—from these opposite phenomena he concluded their causes to be equally antagonistic, and that while opium stimulates the nervous system by an excess of blood, quinia restrains its action by producing a contraction of the bloodvessels and especially of their capillary extremities. The last link in this ingenious induction adapts itself very well to the fact brought to light by the researches of Dr. Hammond and others, viz., that during the paroxysm of intermittent fever the elimination of a large quantity of phosphoric acid with the urine occurs, and is prevented by the administration of sulphate of quinia. As this acid can be derived from the nervous system only, it must cease to be disengaged in excess when the undue action of the blood upon the nervous tissue is prevented.

It does not follow, however, from the demonstrated antagonism of opium and quinia, that the two agents ought not to be simultaneously administered. Their peculiarities of action, on the contrary, would rather indicate that, as in the case of many other medicines, each may serve to qualify the action of the other so as to produce therapeutic effects when they are associated which could not be so readily attained in any other manner. Some of these have been suggested by Dr. Nivison.[1] Thus, in many acute inflammations, experience has shown that opium in full doses constitutes an efficient remedy; but experience has also taught, and the above views explain in what manner, that quinia simultaneously administered prevents the narcotic action of the former remedy, and yet co-operates with it by controlling the action of the capillaries. The latter medicine also tends to prevent the pulmonary congestion which the former may occasion, to moderate the secondary effects of opium, to lessen the tendency to narcotism which it produces in exhausted states of the system, and even to correct the effects of an over-dose

[1] Am. Journ. of Med. Sci., July, 1861, p. 51.

of this medicine. Conversely, the sedative influence of quinia may be regulated and controlled by its judicious combination with opium. In fact the employment of these two medicines according to the peculiar state of disease, and the particular impression desired to be made upon the nervous and vascular systems, affords very many grades of influence which will be found extremely useful in the hands of a skilful therapeutist.

The power which cinchona and quinia exhibit of controlling alcoholic intoxication, and which is illustrated elsewhere, appears to be of the same nature as that which enables them to limit the effects of opium.

Nature of the Action of Quinia.—M. Briquet infers from his own experiments, and from the evidence of other observers, that sulphate of quinia "is not a stimulant, but a cooling and calming remedy."[1] This judgment is inadmissible if applied to small doses of the medicine, but appears to be correct as regards large doses, particularly if the word sedative be substituted for the terms employed by M. Briquet. Such is, indeed, the fact, with respect to other stimulant agents, such as opium and alcohol. Like these, also, quinia may with propriety be regarded as a sedative of morbid excitability in diseases to which it is appropriate; for, in many affections, as typhus fever and delirium tremens, the excitement and derangement of function which characterize them are the result of debility and subside when the nervous system is strengthened by stimulants. But quinia is not merely a stimulant, it exerts a sustained action which diffusible stimulants cannot imitate, and, for a much longer period than they do, fortifies the system against its internal tendencies to morbid action. Unlike them, also, it does not leave behind it a degree of debility proportioned to the excitation which preceded its administration. It is, in other words, a tonic stimulant when given in doses of medium size, as it is a sedative when administered in large doses. In smaller doses still it is purely tonic, and its mode of action would seem to be like that of bitter tonics generally, and to depend chiefly upon a local impression made upon the mucous membrane of the stomach. Apart from that influence of large doses which approaches or even reaches a toxical degree, we cannot find anything in the operation of cinchona which entitles it to be classed with sedative medicines. When administered in large doses, like opium or alcohol similarly given, it directly depresses the activity of the nervous and circulatory systems, and in addition appears to exert some influence both upon the constitution and vitality of the blood, since it is only upon such a supposition that the sanguineous effusions and congestions which it sometimes causes can be explained. Conceding such a change to exist, it must be added to the causes of sedation already admitted.

[1] It may be mentioned that this view of the action of quinia was long ago contended for by Dr. J. W. Monett, of Washington, Miss. (*Am. Journ of Med. Sci.*, Nov. 1833, p. 33) This writer maintained that quinine "contains the febrifuge essence of bark uncombined and without any tonic property whatever." He further declared that it is a febrifuge because it is contra-stimulant.

The researches which have been undertaken by Binz, Scharrenbroich, Martin, Liebermeister, and others in Germany, and by Drs. Murchison, Thompson, and Weber in England, have had some tendency to enlighten this dark region of therapeutics. According to certain of these experimenters, quinia (in common with some other medicines) has a specific influence in checking the vital amœboid movements of the white corpuscles; it hinders their migration through the vascular walls, and checks the generation of new white corpuscles. Hence it is inferred that quinia acts as an antiphlogistic by reducing all the visible factors of suppurative inflammation. On the other hand, it seems to follow, from the clinical observations, especially of Liebermeister and the English physicians, that quinia is an apyrectic through its power of lowering the temperature and the pulse rate in nearly all febrile, but especially in inflammatory diseases. This action has been illustrated by recent experiments of Binz, from which he infers that it depends in greatest part on the power which quinia exerts to prevent the oxidation of the white corpuscles at the expense of the red. An operation of the same nature, though effected by a different mechanism, consists in limiting oxidation throughout the tissues, as shown by the thermometer and by the diminution of nitrogen in the urine. "It does not follow, however, that this is the *only* way in which this and certain other antiphlogistic agents (prussic acid, alcohol) become operative."[1] It would be more satisfactory if these interesting experiments and perhaps important conclusions had received the corroboration of that clinical experience which gives them their chief interest. But hitherto we have found no proof that quinia can either shorten the duration or diminish the mortality of continued fevers, or of inflammations, to any greater extent than medicines which are usually supposed to act as stimulants, and which are used in their treatment.

The inventor of homœopathy imagined cinchona to be capable of generating a febrile paroxysm resembling that of intermittent fever, and, indeed, this notion was a fundamental principle of his system. Here and there in the annals of medicine may be found a case in which a similar effect is attributed to quinia; and we know that poisonous doses of the medicine induce a condition resembling somewhat the cold stage of a malignant intermittent fever. But of the former cases it is sufficient to say that quinia, like other local irritants and tonics, sometimes occasions a transient excitement of the circulation and of the nervous system; and of the latter as well as of these, it may be remarked that quinia, in no conceivable dose or combination, ever generated that which is essential to the disease in question, a periodical succession of similar paroxysms.

Action of the Salts of Cinchona compared.—According to M. Briquet, *cinchonia* affects the nervous system in the same manner as quinia, but is one-third feebler. But the experiments of MM. Bou-

[1] Archiv für experiment. Pathol. u. Pharmakol., i. 18.

chardat, Delondre, and Girault,[1] have led to a somewhat different conclusion. They proved that sulphate of cinchonia is more poisonous to frogs and dogs than sulphate of quinia. They also showed a difference between the two salts in their mode of action upon man. The former does not so speedily produce buzzing in the ears and disordered vision, but, on the other hand, it occasions more constantly than the sulphate of quinia, and in smaller doses, a peculiar pain in the anterior part of the head, with a remarkable sense of oppression there. These phenomena are produced by doses of from twelve to fifteen grains of sulphate of cinchonia, which also occasions, more frequently than the other salt, pains about the præcordia, subsultus tendinum, general debility, and faintness.

Quinidia has the same effects and in the same degree as quinia; and *quinoida* does not differ sensibly from these, except that it is more apt to irritate the digestive tube, producing nausea, a burning epigastric pain, thirst, colic, and diarrhœa. A derangement of the same sort was very frequently produced by *powdered cinchona* while it was still customary to administer this drug, and when it was taken for a long time together, serious symptoms arose from the accumulation of its ligneous particles in the bowels.[2]

[1] Supplément à l'Annuaire de Thérap. pour 1856, p. 153.

[2] The following summary of the action of cinchona and its salts is abridged from M. Briquet, and will perhaps afford the reader, in a brief and connected view, a more distinct idea of this important subject than is conveyed in the text.

Three or four grains of the sulphate of quinia, or an equivalent portion of cinchona, increase the activity of the circulatory, respiratory, and nutritive functions. An agreeable warmth is felt at the epigastrium, and extending thence to the neighboring organs; the pulse rises, perspiration occurs, and all the functions, including those of the brain, are rendered more active. These effects are more distinctly produced by bark than by its alkaloids. If the administration of bark is continued, the blood becomes richer and nutrition more active.

Larger doses, consisting of or representing twelve grains of sulphate of quinia, give rise to a different order of phenomena. Within the first two hours a marked cerebral excitement occurs, with tensive and throbbing headache, morbid sensibility of the eyes to light, buzzing and ringing in the ears, vertigo, unsteadiness of gait, and some palpitation of the heart, muscular quivering, a sense of internal agitation and general excitement; the face is flushed, the skin is warmer, and the pulse and respiration are more frequent. If the dose is excessive, or too frequently repeated, these symptoms may be followed by delirium or convulsions.

This excitement is one of the ill effects of the medicine in large doses, but it can be restrained within due limits by prolonging the intervals between the doses. After it has passed, the sedative influence on the nervous system becomes manifest. Muscular movements are performed languidly, or there is a complete inability to execute them; the sight and hearing grow dull, taste and smell are impaired, aphonia results from paralysis of the vocal muscles, and dyspnœa from impaired energy of those which move the chest. The heart and pulse become feeble, and the temperature of the body falls.

The local action of cinchona and its preparations on the stomach is that of a stimulant within the physiological limits, but of an irritant beyond the latter. Hence, if the gastric mucous membrane is already inflamed, these medicines, and especially the salts, in large doses, may occasion violent reaction, pain, and even ulceration and gangrene. Effects similar in kind may be produced in the urinary passages by the absorption and elimination of quinia. Finally, the prolonged use of quinia may cause a diminution of the red globules, and an increase in the proportion of fibrin and water in the blood.

From these considerations it follows that the salts of quinia, in large doses, are irritants in their local, and nervous sedatives (*stupéfiants*) in their general, opera-

In a report made in 1867 to the Madras government by a committee appointed to investigate the relative values of the several alkaloids of cinchona, the conclusions arrived at were essentially such as have been already stated, and especially that "the evidence does not go to show any particular superiority of one alkaloid over another." Subsequently, in a report to the same government, Dr. Joseph Ewart affirmed the same general proposition, but drew some minor distinctions, one of which was that, in the order of their anti-periodic power, quinia stands first, cinchonidia next, and cinchonia last; but that quinidia is both less repulsive to the palate and the stomach than the other alkaloids. In respect to these qualities, cinchona is even less eligible; it is peculiarly apt to disagree with the stomach, and, therefore, is not fitted to take the place of the alkaloids for internal administration.

Remedial Employment. *As a Prophylactic against Malarious Diseases.*—It has long been believed that cinchona not only cures periodical fevers, but that it also is able to prevent their development in the system. Indeed, as we are informed by Dr. Bryson,[1] there is a standing rule in the British navy, when seamen are sent ashore in tropical malarious regions, that a dose of bark in wine shall be administered to each man as a prophylactic medicine. Owing partly to a neglect of this rule, or a repugnance to taking the nauseous dose, and partly to the inadequate mode of its administration, confidence was lost in the efficiency of the prescription. But of late years a different system has prevailed. Amorphous quinia dissolved in wine has been substituted for bark, and it has been given not only on the day of exposure, but also for fourteen days after the exposure has ceased. Various testimony is cited by Dr. B. to prove that on the most pestilential of all naval stations, the western coast of Africa, the crews of vessels can be kept nearly free from malarial fevers, chiefly by means of the measure which has been described. These statements have been fully confirmed by the subsequent experience of Mr. Hayne upon the same station,[2] by British army and navy medical officers in the Crimea, in India, and in South America, and by explorers of the western coast and the rivers of Africa. American physicians have not been behind their foreign brethren in perfecting the demonstration of the precious truth which enables soldiers and sailors in discharge of their duty, and commercial adventurers in quest of gain, to pass unscathed through an atmosphere saturated with poison. As early as 1840, Dr. Van Buren, while assistant surgeon U. S. A., at Tampa Bay, Florida, was sent to Fort King, an interior post, where a serious outbreak of miasmatic disease had just occurred. He prepared an alcoholic infusion of logwood and wild cherry barks, and of orange-peel, which, with the addition of sulphate of

tion, somewhat like ether, chloroform, and even prussic acid. In those preparations of bark, on the other hand, which contain the largest amount of extractive matters, the tonic and astringent properties predominate.

[1] Times and Gaz., Jan. 1854, p. 6. [2] Ibid., March, 1855, p. 281.

quinia, was successfully used both as a curative and a prophylactic medicine. In 1855 the use of a wine of quinia enabled the Panama line of steamers to continue their service during the sickly season, "and has ever since been found to reduce the number of sick in this service to a mere fraction of its former amount, while it has preserved from disease in a remarkable manner the officers and dependants of the company on the Isthmus."[1] In 1860 Dr. H. W. De Saussure published several very striking, and what may be regarded as crucial instances of the prophylactic power of quinia upon the rice plantations of South Carolina.[2] During the summers of 1862 and 1863 Dr. Derby fully tested the prophylactic virtues of quinia in the case of the 23d Massachusetts regiment, stationed near Newbern, N. C.[3] Dr. J. K. Merrit, the surgeon of a mining and exploring party upon the Isthmus of Darien, states that for more than two years the party enjoyed an almost complete immunity from miasmatic disease under the systematic use of quinia. It was given daily immediately before breakfast, and generally in clear cold coffee, which masked its peculiar bitterness. Sometimes the dose was repeated in the evening, and then was administered in half a gill of whiskey.[4] These statements are confirmed by the later experience of Dr. Stephen Rogers in the same locality. He is, however, of opinion that the continued use of the medicine for an indefinite period is unnecessary, because gradual acclimation diminishes the danger of being attacked by the more violent forms of miasmatic disease.[5] Upon this point, it may be remarked, experience has not yet pronounced a definitive decision. General observation leads, rather, to the conclusion that habitual exposure to the causes of periodical fevers establishes no such tolerance of their influence as is well known to exist in the case of yellow fever and some other endemic diseases. A more probable statement is that when continuously administered for a long time quinia ceases to exert its prophylactic power. A more recent report, based on a comparison of two bodies of men in the same locality, one of which used, and the other did not use, quinia, confirms the statements already made. Dr. Hamilton, in the East Indian medical service, being stationed at a very insalubrious post, succeeded in protecting his men by the daily administration of quinia, while another regiment, at the same station, for which this precaution was omitted, suffered severely from malarial disease.[6]

Periodical Diseases. Intermittent Fevers.—It is unnecessary to adduce any proofs of the virtues of cinchona as a remedy for these affections. The medicine is a specific for them, and is universally recognized as such. But the most perfect instruments fail of accomplishing their purpose if they are not used aright, and there-

[1] Report on Quinia as a Prophylactic against Malarious Diseases, 1861.
[2] Charleston Med. Journ., etc., xv. 433.
[3] Boston Med. and Surg. Journ., Oct. 1863, p. 169.
[4] Am. Med. Times, iii. 305.
[5] Boston Med. and Surg. Journ., August, 1862, p. 59.
[6] Am. Journ. of Med. Sci., Jan. 1873, p. 215.

fore it is important that we should know what are the conditions under which cinchona best displays its marvellous powers of cure.

1. *Preparatory Treatment.*—Certain vague notions in regard to the pathology of intermittent fevers, and the importance of removing splenic and hepatic congestions, and restoring the balance of the circulation,[1] led to the use of depletory and evacuant measures, which, whatever else they may have done, debilitated and prostrated the patient. "Depletions," according to Dr. Copland, "are almost indispensable preliminaries to the quinine or bark, especially in the complicated or congestive forms; for without them it will either not be retained on the stomach, or, if retained, will convert congestions, or slight forms of inflammatory irritation, to active inflammation, or to structural change." This precept appears to have been fully acted upon by the greater number of East Indian practitioners,[2] who also coupled with it an extremely feeble method of administering quinia. This consisted of giving doses of two or three grains every three or four hours during the apyrexia, a method wholly inadequate to attain the object in view. But even in the region where the preparatory treatment above described was most in vogue, some physicians were found to abandon it in favor of a more efficient plan. Dr. Morehead denounced it,[3] and urged the administration of quinia at the very earliest intermission, in three doses of from four to six grains each, every other hour, immediately before the expected paroxysm. Still more striking evidence in support of the method of resorting early to the antiperiodic will be adduced in the sequel. Undoubtedly, gastric and congestive derangements often complicate intermittent fever; but they are usually under the immediate dependence of the malarial element, and when this is counteracted by the specific medicine they spontaneously subside.

2. *Bark and Quinia compared.*—Since the introduction of the alkaloids of cinchona into practice, it has become almost universally the custom to prefer them to bark itself.[4] There is some reason to doubt whether this substitution is always advantageous. As we have seen, bark contains other febrifuge elements besides quinia, and also certain tonic and astringent principles. MM. Trousseau and Pidoux, assuming that sixty grains of bark contain

[1] As a specimen of this vague style of reasoning the following may be quoted: "Other remedial agents should always be conjoined with the quinine, and often precede its employment, to effect the restoration of a sufficient degree of equilibrium between the different forms of the automatic nervous force to enable it to consume, by cellular action, in a safe and efficient manner, the excess of the chemical force."—*Quinine in Fever*, by J. Casselberry.

[2] MARTIN, Influence of Tropical Climates, p. 194.

[3] Diseases of India, i. 42.

[4] In 1823 sulphate of quinia was first used in England by Dr. Elliotson. Speaking of the rapidity with which violent cases of intermittent fever were cured by very small doses of the new drug, he wittily quoted these lines from Virgil's Battle of the Bees:—

"Hæc certamina tanta,
Pulveris *exegui* jacta, compressa quiescunt."
Med.-Chir. Trans., xii. 563.

about two grains of quinia, say that an intermittent fever ought to be as curable by means of four grains of quinia as by one hundred and twenty grains of bark. But such is not the fact. On the contrary, twelve and even fifteen grains of sulphate of quinia are necessary to produce the curative effect of one hundred and twenty grains of bark. The latter, it is true, contains a certain proportion of other alkaloids, but not enough in itself to account for the alleged differences in the effects. These may, perhaps, depend, in part, upon the gradual manner in which the febrifuge principles of the bark are extracted from it in the digestive organs, and partly also upon the tonic and astringent elements with which they are associated. Undoubtedly the use of the bark is more economical than that of quinia, and should, even on that ground, be preferred where expense is to be avoided, as in hospitals and among the poor. The objection founded upon its taste and bulk is not of much importance, except when the patient is unusually fastidious. If it be said that powdered bark is very liable to adulteration, it may be answered, not more so than the salts of quinia and cinchonia, which are constantly the subjects of fraudulent manœuvres. Cinchona is an antiperiodic, and also a tonic, but quinia, which is eminently antiperiodic, is but slightly tonic, and only when given in small doses. In chronic periodical diseases, then, where a tonic and corroborant influence is required in addition to a febrifuge operation, quinia may become incompetent to the cure, which will be readily accomplished by cinchona, either alone or associated with preparations of iron. Then the reconstituent influence of the latter medicine joined to the antiperiodic and tonic powers of the former, triumphs over both elements of the disease; the digestion improves, the blood becomes more abundant, and richer in red globules, the complexion regains its natural hue, and the nutritive function its original activity and strength.

The distinction here insisted upon, and which is of the highest practical importance, is not a novel one, although it is too often lost sight of in practice. Even in 1828, Dr. Vulpes, of Naples, claimed for bark a superiority in all "putrid fevers," while he regarded quinia as specially applicable to periodical affections, and especially intermittent fever and neuralgia.[1]

Many of the trials by which the degree of antiperiodic virtue possessed by cinchona has been estimated, were made in places where miasmatic influences do not prevail, and without taking into account the fact that a large proportion of cases of periodical fever get well spontaneously when they are transferred to a healthy situation and are otherwise surrounded by favorable healthy conditions. M. Michel Lévy informs us that at the Lille military hospital the physician in charge cured intermittent fever with pure water which he dispensed in vials labelled "Protoxide of Hydrogen." The cases, therefore, which have been treated in the public institutions of this city, of Paris, London, Munich, and Rome, are of

[1] Archives Générales, xvii. 135. For a further comparison between cinchona and quinia, see Jacquot, Arch. Gén., 4ème sér., vi. 78.

comparatively little weight in solving the question of the relative value of the two principal alkaloids of cinchona. The antiperiodic powers of cinchonia have, however, been fully tested in malarious regions. Dr. Hinkle, of Lancaster Co., Pa., has reported it to be equal if not superior to quinia,[1] and Dr. Porcher, of Charleston, confirms the opinion.[2] More extensive and perhaps more circumstantial observation appears to show that it is slightly inferior to quinia, at least when prescribed in the same dose, and also that its medicinal effects are rather more slowly developed,[3] and hence that they cannot so fully be depended upon when rapidity and energy of action are essential.

3. *Quantity required.*—In the early use of cinchona small doses of it were administered. Torti prescribed no more than an ounce of bark to prevent the paroxysms of malignant intermittent fever, and for simple cases the dose was a drachm.[4] But Cullen declared that the smallest quantity he had found to cure an intermittent was at least six drachms during the apyrexia, and he thought it safer to give an ounce or more. He adds, however, that but few stomachs will bear more than two drachms at once.[5] It is probable that the medicine was not of the same quality in the two cases. Until within a few years, and before the powers of bark had been fully investigated, it was customary, except in the Southwestern States of this country, to give six or eight grains of sulphate of quinia in divided doses during the intermission. Although this method was generally successful in the end, at least in curing the simple forms of intermittent fever, it rarely produced its effect until several paroxysms had elapsed. But later experience has shown that the disease can be abruptly arrested by a single dose of from five to eight grains in simple intermittents, and of fifteen or from that to thirty grains, in congestive intermittents, or by this quantity taken in two or three doses. In this manner a costly medicine is economized, and the system saved from the repeated shocks of the disease. As already intimated, large doses of quinia were given at an early period in the United States. In 1826 Dr. Perrine, of Natchez, published an account of several cases of intermittent fever, in one of which he administered eight grains of the sulphate every three hours, until sixty-four grains had been taken.[6] About the same time, it may be mentioned, Chomel stated that he had frequently given as much as sixty grains of quinia in a day for tic douloureux.[7] But these were unusual instances.

4. *Time of Administration.*—In the beginning, the method recommended by Torti was the one generally adopted. It consisted in administering a full dose of bark immediately before the paroxysm, not with the hope of preventing it, but in order to operate more certainly upon the succeeding fit. This haste is wholly unnecessary, except in certain malignant cases approaching the type of remittent

[1] Trans. Am. Med. Assoc., x. 152.
[2] Charleston Journ., xiii. 479.
[3] Bull. de l'Acad. de Méd., xxv.
[4] Op. cit., lib. iii. cap. iii.
[5] Works, i. 641.
[6] Philad. Med. Journ., xiii. 39.
[7] Archives Gén., xvii. 136.

fever. The bark given in the early part of the apyrexia is always in time to moderate or prevent the coming paroxysm; but if exhibited immediately before a paroxysm, it is sure to aggravate it, however favorably it may affect the one that follows. Sydenham, looking upon the fit as an effort of nature to throw off some noxious matter in the blood, gave the powder immediately after the fit, and at regular intervals during the intermission. According to him, it was better "to imbue the blood with the drug moderately, gradually, and at long intervals before the fits, than to attempt, by a single blow, to cut short the paroxysm at its accession."[1] But having arrested the paroxysm, the medicine was suspended, and resumed at the end of the first and also of the second week. Home concluded, from the experiments which he instituted in regard to this subject, 1. That bark is more efficacious in stopping the paroxysms of intermittents, and curing the disease, when given at the end of a fit, or at forty hours' distance from the succeeding fit, than two, three, or four hours before it. 2. That bark given a few hours before the fit seems to add to its severity. 3. That fifteen or sixteen hours are a sufficient time to enable the bark to operate. But, asks this author, does it not require at least two or three days before all its good effects are produced?[2] Cullen refers to a custom, which prevailed in London in his time, of giving a large dose of bark immediately on the approach of the fit, and of this he says, he is satisfied it "is the proper practice."[3] This method, which has been very generally followed by English,[4] and partially by American authorities,[5] has not the support of those who have made the largest comparative trials of the different methods. The latter have adopted more or less completely the methods of Torti, Sydenham, Morton, and Home. Thus, Bretonneau says that a single dose (fifteen grains) of quinia, sufficient to occasion marked physiological phenomena, or at most two such doses given upon successive days, will afford protection against the paroxysms of simple intermittent for a week.[6] These doses he administered as far as possible from the coming paroxysm. In order to prevent relapses, he directed the same dose to be given at the end of five days, and afterwards of eight days for a month. M. Trousseau modified this plan as follows: Fifteen grains of quinia are given immediately after the paroxysm; the same dose is repeated after an interval, at first of one, then of two, then of three, and then of four days. In cases of long standing, the medicine should still be continued at intervals of five days, and afterwards of ten, fifteen, and twenty days. An advantage belonging to this method over that of giving more moderate but daily doses of the medicine for a length of time, is that it avoids the danger inherent in the latter course, of deranging the stomach and of creating an artificial intermittence, or of rendering the system tolerant of the medicine, and at last insusceptible

[1] Works (Syd. Soc. ed.), ii. 13 and 18.
[2] Clinical Experiments. Lond. 1783.
[3] Mat. Med., ii. 97.
[4] PEREIRA, Mat. Med. (3d Am. ed.), ii. 686.
[5] CHAPMAN, EBERLE.
[6] Journ. de Méd., iii. (1845), p. 66.

to its influence.[1] Dr. Graves was perhaps the first to call attention to this subject; for after a comparative trial of several methods of administering quinia in a case of obstinate quartan ague, he came to the conclusion that it is best "to give no quinia until a well-marked fit, or shadow of a fit, occurs, and then at once to use the medicine in large doses;" for, as he remarks, if the medicine is continued throughout the apyrectic interval, the system becomes accustomed to its impression, and is less powerfully affected than when it is taken only at such times as the derangement which it is adapted to remedy is about to occur.[2]

M. Briquet, who prefers administering quinia in divided doses, arrives at the following conclusions relative to the proper time for its administration. When the last dose is given at the approach of the fit, its influence upon the latter is seldom manifested; and when this dose is given from four to eight hours in advance, the fit is moderated, or prevented in one-half of the cases; but in some of the remainder the succeeding fit is prevented, although no more of the medicine may have been taken. When a period of twelve hours intervenes between the last dose of the medicine and the hour of the attack, this latter generally fails to occur, and the succeeding paroxysm always. When the medicine is given from fifteen to thirty hours before the time of the fit, it is uniformly successful in preventing the attack, and the former period is the one which M. Briquet adopted as the best of all between the last dose of the medicine and the hour of the paroxysm. As the cases treated by M. Briquet included every type of intermittent fever, from quotidian to quartan, and were all more or less marked by malarial cachexia, and with enlargement of the spleen, they offered a sufficient and conclusive test of the plan of treatment applied to them.[3] It is of great importance to notice here that the anti-febrile influence of quinia does not coincide with its physiological operation, either in time or in degree. A dose of six grains, for example, is sufficient to prevent the occurrence of a febrile paroxysm fifteen hours afterwards, and yet its direct and sensible action upon the system may be imperceptible, or, if decided, may entirely have passed away before the period of the next paroxysm. This fact, which modern observation and experiment have rendered positive, refutes completely the notion that the antiperiodic operation of bark is explicable by its sedative influence upon the nervous system, and leaves us again without other resource than to adopt the hypothesis that quinia eliminates a morbid poison from the system, or else to take refuge under the convenient cloak for ignorance, the recognition of a specific virtue, *virtutem febrifugam*, in bark.

The method which is here advocated is pursued by the best authorities in all parts of the world. Thus, Bretonneau says: "It has been ascertained that the prolonged administration of repeated doses, amounting in all to several effective doses of the medicine,

[1] Trousseau and Pidoux, Thérap., 5ème éd., ii. 350.
[2] Dub. Quart. Journ., Feb. 1846, p. 72. [3] Op. cit., p. 599.

is perfectly nugatory. A quartan ague, which resisted two ounces of bark given in the course of a fortnight, has been known to yield to two drachms of the same bark in a single dose. So wine does not display its intoxicating power when taken in small portions at a time."[1] Dr. Austin Flint found that the most effectual method of treating intermittents was to give twenty or thirty grains of quinia at once, or, in divided doses, at short intervals, at the early part of the intermission.[2] Dr. Upshur, of Virginia, followed the same plan, although he was not prevented from administering quinia even in the hot stage. He then found the pulse to decline under large doses of the medicine.[3] In the same way Dr. Murchison, when in the Bengal service, administered twenty grains of sulphate of quinia at a single dose during the sweating stage. In three-fifths of the cases no further treatment was required.[4]

Malignant Intermittent Fever.—Although the proper administration of quinia in this form of disease may, in great part, be inferred from the preceding remarks, it will not perhaps be amiss to devote a few words specially to the subject. The necessity of employing very large doses for its cure was fully recognized by Torti, who gave a quantity of bark equivalent to about thirty grains of quinia during the apyrexia. The experience of recent times, and especially that of the army surgeons in Algeria, fully sustains the propriety of the treatment. In these diseases it may be necessary to employ depletion, evacuants, and revulsives; but such means are of little avail without the addition of quinia. Nor should the violence of the symptoms deter from its administration. Whatever else it is advisable to do, this is essential; and often, if it does not absolve from the necessity of resorting to other measures, it renders them more efficient. It must, however, be administered in large doses—such as twenty or thirty grains—during the apyrexia. If the stomach rejects it, it may be introduced by the rectum: or if the bowels themselves are irritable, or if diarrhœa prevents the medicine from being retained, it may be associated with black drop or some other opiate; or it may be administered hypodermically. The largest doses of quinia are required in the algid forms of intermittent fever. Maillot relates a case of this affection in which forty grains of sulphate of quinia, with a drachm of sulphuric ether, were given by the mouth, and sixty grains of the salt by the rectum, within an hour. The following day reaction had commenced, but was not fully established, and the prescription was repeated. In another day, the patient was out of danger. It is remarkable that in such cases, treated in the manner described, the reaction that

[1] Journ. de Méd., iii. 66.

[2] Am. Journ. of Med.-Sci., October, 1841, p. 277.

[3] Phil. Med. Exam., March, 1847, p. 143. Dr. Wustling, of Dauphin County, Pa., found that fifteen grains of sulphate of quinia, given during the hot stage of a quotidian ague, rendered the pulse feeble, infrequent, and irregular, while coolness of the skin, deafness, profuse perspiration, and convalescence succeeded.—*MS. Inaugural Thesis*, 1866.

[4] Edinb. Med. and Surg. Journ., January and April, 1855.

ensues is not violent, and indeed is probably much less so than if it had been accomplished by the unaided struggles of nature.

Remittent Fever.—Sir James Annesley, and most other East Indian practitioners, insist upon the necessity of prefacing the use of bark by evacuant and depletory measures. Mr. Martin informs us that in former times, when bark alone was relied upon for the cure of all tropical fevers, the results were horrible, and he reaffirms the necessity of employing depletory means as introductory to the use of the medicine, which, he adds, should be given "in large and often repeated doses."[1] Without doubt, many cases will bear such treatment, and it may not often be productive of serious injury, but its necessity is so far from being demonstrated, that there is rather ground for believing that it only postpones injuriously the use of really curative means. It has been clearly shown by Dr. Boling, that "cases originally violent almost invariably die while *preparing* for the quinine, and those of moderate severity become worse under this *preparation.*"[2] Nor is the existence of a topical inflammation or congestion a contraindication to this treatment. Now that it is certain that large doses of quinia are directly sedative in their action, we can in part explain why, under their influence, the local symptoms of the attack, instead of being aggravated, are actually mitigated. But we must also remember, what has before been insisted upon, that the local disturbances are subordinate to the miasmatic poisoning, and that they subside in proportion as it is counteracted, or its cause is eliminated. At the same time it would be uncandid not to admit that when no contraindication exists, the moderate use of evacuant remedies (emeto-cathartics) renders the operation of quinia more certain, and in a less dose than would otherwise be required.

In regard to the proper time for the administration of the medicine, the remission is to be preferred, and from twelve to sixteen grains should be given in one, two, or three doses, with an hour's interval between them. But if the paroxysm has already commenced, and the symptoms are very urgent, as in the congestive forms of the disease, no time should be lost in prescribing the antidote in double the quantities just named, and at shorter or longer intervals, according to the duration of the remission. After control has been obtained over one paroxysm, the medicine may be exhibited in doses of one-half the original quantity, or even less, for two or three periodical revolutions. This method, which originated in the United States, and has the sanction of the most eminent American physicians, has been put into practice by those of other countries, and especially by the French army surgeons in Africa, and the English practitioners in India. Mr. Morehead, in his work already quoted,[3] advises to give four or five grains of quinia four or five times during the remission, and in the inflam-

[1] Influence of Tropical Climates, p. 166.
[2] Am. Journ. of Med. Sci., July, 1846, p. 42.
[3] Disease in India, i. 181, 195.

matory form to increase each dose to five or eight grains. In the cerebral form, he remarks, "It matters not what the nature of the cerebral symptoms may be, the treatment of the febrile remission with adequate doses of quinia is a ruling indication." Other physicians, in the same country, particularly Drs. Corbyn, Mackinnon, Mactier, Murchison, and Hare, gave scruple doses of quinia in the remission with a success far superior to that of their colleagues who followed the older method. The last-named gentleman, who was Deputy Inspector-General of Hospitals, Bengal, and has published an interesting history of the employment of cinchona and its salts in the treatment of malarious fever,[1] prescribed quinia as an antidote irrespective of all varieties of the symptoms. "Quinine," he remarks, "may be given in the largest doses, whether there are head symptoms, delirium, coma, or pain in the liver. Whether it be in the hot stage or cold, quinine is not only safe for all forms of malarious fever, but is its certain cure." The mortality under this treatment is stated to have been less than one-half of one per cent., while by the ordinary method employed by British army surgeons it was six times as great.

Enlargement of the Spleen and Dropsy.—Piorry, it is well known, entertains the singular notion that periodical fevers depend upon enlargement of the *spleen* as their organic cause, and that a cure of the former is effected by a contraction of the latter under the influence of quinia. It is unnecessary to combat so gratuitous a hypothesis, but the fact is still an interesting one, that in many recent cases of intermittent fever, with enlarged spleen, this organ actually contracts under the primary and often the immediate influence of the medicine. This has been shown by Dr. Smith, of the Madras Medical Service. Out of seventeen experiments with large doses of quinia, in cases of enlarged spleen, a greater or less diminution of the organ occurred in eleven.[2]

The *dropsy* following ague is sometimes cured by preparations of bark. Three such cases, which resisted diuretics and purgatives, are reported by Dassit.[3] It is not improbable that these cures were secondary to a reduction in the size of the spleen.

Intermittent Non-miasmatic Affections.—It is in neuralgic affections of this type (which will be considered hereafter) that quinia displays the greatest power. But it is also efficacious in other intermittent affections. Giannini relates a singular case of intermittent fever caused by the introduction of a catheter. Numerous paroxysms occurred regularly until bark was administered. Two years afterwards, on the catheter being introduced, it produced, as on the first occasion, pain, hemorrhage, and a chill, followed by fever and sweating, and a similar paroxysm returned eight times, at irregular intervals. The attack ceased under quinia as before. Three years later, the same accidents and the same mode of cure were renewed,

[1] Times and Gaz., Nov.—Dec. 1864.
[2] Month. Journ. of Med. Sci., Oct. 1851, p. 359.
[3] Bull. de Thérap., xvi. 112.

and subsequently still another attack, more obstinate than the preceding, took place.[1]

M. Fallot reports a singular case of *conjunctivitis*, in which the inflammatory symptoms occurred daily in the afternoon, and resisted all treatment until quinia was administered, and then the attack ceased abruptly.[2] It by no means follows, however, that all intermittent or paroxysmal affections, or even those which present the phenomena of intermittent fever, are curable by quinia. Sometimes such intermittence has its origin in a local irritation or suppuration, and in that case the removal of the cause is the only effectual remedy. Many cases of intestinal worms, and of pelvic, renal, and hepatic abscess, belong to this category. Paroxysmal fevers depending upon hepatic disease have been pointed out by Portal as peculiarly intractable to the anti-periodic treatment.

Other Alkaloids of Bark in the Treatment of Periodical Fevers.—When first used by Chomel the sulphate of *cinchonia* appeared to be less efficient than it afterwards proved in the hands of Dr. Bardsley, who, in 1830, published nine examples of its complete success.[3] M. Hudellot, of Bourg (Ain), treated 509 cases of intermittent fever with sulphate of cinchonia, and found it equally effectual with quinia in the same doses, both as a curative and as a prophylactic medicine.[4] Indeed, all writers of authority in the matter, as Strumpf (1848), and Schroff (1856), assign to the salts of cinchonia and quinia an equal degree of efficacy. In this city numerous trials made in 1852, by Dr. Pepper, at the suggestion of Prof. Carson,[5] and others by Dr. A. P. Turner, in 1863,[6] go to confirm the results of previous experimentation. We have been assured by Dr. C. Q. Chandler, of Missouri, that in his hands sulphate of cinchonia never produces the head symptoms often occasioned by quinia, but is much more apt to cause disagreeable nausea. The inferior cost of sulphate of cinchonia should cause it to be preferred whenever it is an object to avoid expense, as in hospitals and other medical charities. It is usually given in doses about one-third greater than those of the sulphate of quinia. Dr. Cullen has partially reported the results of the use of sulphate of *quinidia* in the treatment of 180 cases of intermittent fever at the Philadelphia Hospital. Of these cases, 111 were of the quotidian, 35 of the tertian, and 31 of the tertian and quotidian types successively. In 129 cases the paroxysms were arrested by fifteen grains of the salt.[7] Similar results have been obtained by Dr. Peacock, who is of opinion that quinidia is less apt than quinia to disagree with the stomach, or to cause unpleasant nervous symptoms.[8] *Amorphous quinia*, quinium, or quinoidia, is capable of checking intermittent fever, in doses two-thirds larger than those of sulphate of quinia. Dr. Da Costa found that in 49 out of 53 cases of quotidian or tertian intermittent fever,

[1] Cuvier, Thèse de Concours (1838), p. 23.
[2] Journ. Complémentaire, xxxiv. 262.
[3] Hospital Facts and Obs., p. 133.
[4] Revue Méd., Dec. 1854.
[5] Am. Journ. of Med. Sci., Jan. 1853, p. 13.
[6] Ibid., April, 1864, p. 396.
[7] Ibid., Jan. 1855, p. 81.
[8] Times and Gaz., Nov. 1856, p. 442.

the paroxysms were arrested by the first day's administration of the medicine, to the amount of twenty grains.[1]

Mode of Action of Cinchona in the Cure of Periodical Diseases.—The description furnished in the preceding paragraphs may, perhaps, assist us in forming an opinion regarding the manner in which cinchona becomes a remedy for periodical fevers. Originally a doctrine prevailed, and was strenuously defended by Morton, that the essential cause of periodical fever is a material agent, which he compared to a ferment. At that period the belief in such an agent did not rest upon the probable ground which the experiments and observations of Lancisi afterwards afforded it. From the time of the latter, the doctrine of Morton, although occasionally obscured by transient medical systems, continued to be accepted by all the leading medical investigators of the subject, and is so at the present day.

It has, indeed, been urged against this opinion, that intermittent neuralgic, and other local affections, not of a miasmatic origin, and occurring in regions where no sources of miasm exist, are nevertheless curable by means of bark. This fact cannot be denied; yet, because non-miasmatic neuralgia in one place, and miasmatic fever in another, alike observe the law of periodicity, and both are curable by quinia, we are not at liberty to conclude that the nature and cause of the periodicity are the same in both cases. In truth the mightiest phenomena of the universe, as well as the simplest functions of the animal economy, are governed by a law which impresses periodical mutations upon every animate and inanimate thing. This is strikingly visible when we study the revolutions of the animal functions, the uterine, digestive, and nervous, for example. It is not unreasonable to suppose that various causes may render actions morbidly prominent as intermittent phenomena, which usually pass unnoticed. Such a case is presented in the intermittent fever developed by mental excitement, by the irritation of the urethra by a bougie, of the bowels by worms, etc. But the whole history of true periodical fevers points steadily to the cause which nearly all observers have assigned to them, a material poisonous effluvium from decomposing vegetation. If cinchona cures diseases marked by both forms of periodicity, it does not necessarily cure them in the same way. It may counteract periodicity in the one by regulating and moderating a disorder of the nervous system, and in the other by directly neutralizing a material poison, or causing its elimination from the economy. It is true that the latter proposition does not admit of direct demonstration; but, admitting that a morbid element in the blood is the immediate cause of the paroxysms of periodical fever, some such mode of cure appears to be the most consistent with probability. For, looking only at the simpler forms of the disease in its early stage, and before any cachexia has been established, it is certain that the febrile paroxysms are arrested permanently by doses of quinia, which have no

[1] Med. Examiner, May, 1853, p. 295.

other sensible influence upon the vital phenomena. The antidotal power of the medicine is quite as evident as that of mercury or iodine in constitutional syphilis, or of the latter medicine in poisoning by lead, although the material proof existing in the last-named case may be wanting in the two other cases. Moreover, just in proportion as periodical fevers are complicated with local inflammatory or other derangements, either primarily connected with the disease, or resulting from its long continuance, is the specific action of quinia impaired or lost, unless such derangements are immediate manifestations or effects of the morbid cause. On this account, probably, remittent fevers are less completely under the control of the medicine than those of an intermittent type, no matter how grave the latter may be. Yet even remittent fevers which approach the continued type most closely are more curable by quinia than by any other means, and their inflammatory and functional derangements subside under the medicine with a rapidity and completeness which are less explicable on any other supposition than on this, viz., that the quinia has destroyed, eliminated, or rendered inert some noxious principle contained in the blood.

The results of administering quinia at different periods before the paroxysm amply confirm the view of the subject which has here been taken. The sensible effects of a full dose of it are completely developed at the end of five or six hours, and yet it has been thoroughly demonstrated that in order most effectually to prevent a paroxysm quinia should be administered between twenty-four and forty-eight hours in advance of the attack. Now, even when buzzing in the ears, and headache, with some confusion of sight, are produced, these symptoms begin to appear within half an hour after the medicine is taken, and subside within a period of from eight to ten hours. It is, therefore, after the sensible effects have ceased, that the curative power of the medicine is most strikingly exhibited. No medicine which operates simply by exalting or depressing the organic actions possesses this peculiarity, one which it seems impossible to comprehend except upon the supposition that its eliminative or antidotal, and not its dynamical action, is the chief agent in the cure which it achieves.

The more attentively the operation of quinia in malarial disease is examined, the more difficult will it be found to explain it by supposing that the virtue of the medicine resides either alone or chiefly in the sedative operation which large doses of it manifest, or in the stimulant action which is displayed by smaller quantities. If we were compelled to adopt either sedation or stimulation as the exclusive key to its effects, we should find the latter to be best suited for the purpose; for what, after all, is a paroxysm of intermittent fever but a chill? This is its essential phenomenon. The fever which follows is but a reaction from the chill, and the sweat but a resolution of the fever. And, in those forms of miasmatic fever which tend towards continuity, and in which the initial chill is perhaps the only one of the attack, a local inflammation or congestion sustains the febrile action, and prevents the periodical

depression which would otherwise ensue. But this excitation is continuous and essentially morbid; it exhausts the powers of life, instead of enabling them successfully to resist the disease. If, instead of such a stimulus, the system, laboring under intermittent fever, experiences one that is salutary in its nature, the paroxysms may very often be arrested. When patients affected with this disease in the midst of a malarious locality are removed thence to a salubrious residence, the change of air in many cases suffices for the cure. The charms and amulets which occasionally suspend the attack can operate only by exciting the mind with hope or faith. The medicines, other than bark, which have been most renowned for the cure of intermittent fevers are all stimulants in small doses. Opium, on which the ancients depended for this purpose, and which no prudent physician will even now neglect; wine and abundant food, which, in the marshy districts of Europe, are still regarded as preservatives against the disease; the whole class of sudorifics, including hot bathing, violent exercise, etc.; above all, arsenic, the succedaneum for bark, and whose stimulant, tonic, and eutropic properties are so remarkable; all of these agents show, by their cure of intermittent fever, to which of their properties cinchona and its preparations chiefly owe their virtues. Let it also be remarked, that every one of these *succedanea*, when administered in large doses becomes sedative in its action. Excessive exercise exhausts, alcohol and opium narcotize; and arsenic produces a sedation which has many points of analogy with complete cinchonism.

We are far from attributing to the stimulant virtues of quinia the chief part of its curative effects, for the reason already assigned, viz., that the latter are most fully developed when the former have quite passed away; but the preceding considerations (which might, indeed, be greatly extended) prove that in doses sufficient to cure intermittent fevers, its operation is not necessarily sedative. If it should still be objected that enormous doses of quinia are necessary in pernicious forms of periodical fever, we reply that in such cases the medicine manifests none of its toxical properties, or only does so in a moderate degree. Do the malarial poison and the quinia, then, neutralize one another? If they do not, and the remedy acts physiologically, is it in virtue of its sedative operation that it counteracts a tendency stronger than exists in any other disease, to a complete prostration of the vital powers? Let it be observed that the extraordinary doses of quinia referred to are given, and with the comparatively trifling effects stated, in the apyrexia, and when there is no visible tendency to counteract the natural operation of the remedy. But since its sensible operation is singularly slight, we are compelled to conclude either that it is not absorbed, of which there is no evidence, or that it is counteracted by the material poison which, upon grounds already stated, we must presume to exist in the system.[1]

[1] As these doctrines are opposed to those which the admirable researches of M. Briquet have led him to adopt, the following epitome of his conclusions is here subjoined.

"The alkaloids of cinchona arrest the intermittent paroxysms of diseases, what-

The nature of the antidotal action referred to in the preceding paragraphs has received some illustration from the facts which will now be adduced, and which seem to show that quinia is competent to supply a substance in the economy which it is the property of malaria to destroy. Some years ago, Dr. H. Bence Jones, while endeavoring to determine how small a quantity of quinia given to an animal could be detected in its blood by spectrum analysis, discovered that in the tissues of guinea pigs that had taken no quinia, the spectral band distinctive of that substance was present. Assuming that this fact demonstrated in the animals the presence of a substance resembling quinia, he named it animal quinoidine. When quinia was administered to these animals the sign in question was at first greatly intensified; it declined however, hour by hour, until at the end of several days, only the natural degree of fluorescence could be detected.[1] These facts led Dr. Jones to the conclusion summarily stated above, but no counter experiments were made until those performed by the late Dr. Rhoads and by Dr. William Pepper of Philadelphia. Having an opportunity of examining the blood of persons affected with malarial diseases and who had taken no preparation of cinchona, they compared its degree of fluorescence with that of healthy blood. The latter presented a fluorescence equal to 3, while of seven persons affected with intermittent fever, only one possessed this quality to the degree of $1\frac{1}{2}$. In one person it reached the degree of 1; in the remaining five it was represented by a number less than one, and in one case was entirely destroyed. To these persons cinchona was regularly administered for a fortnight, when the fluorescence was represented by $\frac{1}{4}$ in the latter case and by $3\frac{1}{2}$ in the former.[2] These experiments and observations corroborate one another strikingly, and render probable an explanation which, if not absolute and complete, is at least much more intelligible than any exclusive doctrine on the subject. It may therefore be noted as a singular fact that neither have the experiments been repeated, nor the conclusions of these observers received that amount of attention which such novel and striking views were adapted to elicit. It is to be observed that they by no means exclude the doctrine of a primary action of quinia upon the nervous system as a stimulant, but only seem to imply that a certain proportion of "animal quinoidine" in the tissues is necessary to the normal action of that system.

Yellow Fever.—Peruvian bark was early employed in the treat-

ever their cause or nature, by lowering the action (*hyposthénisant*) of that portion of the nervous system which is concerned in the paroxysm, especially that which controls calorification and the circulation of the blood. It deprives this portion of the nervous system of its power to combine and direct the harmonious actions essential to the making of a united effort—to the accomplishment, that is, of the morbid operation which constitutes an intermittent paroxysm." (*Op. cit.*, p. 352.)

In justice to an accomplished physician and distinguished author, we should state, that as early as 1840, Dr. John Bell, of Philadelphia, published his conviction that quinia cannot "properly be called either a tonic or a stimulant, but that it is, to all intents and purposes, a sedative."

[1] Lectures on Pathology and Therapeutics, Lond., 1867.

[2] Pennsylvania Hosp. Reports, i. 269.

ment of this disease, either as a curative agent, or as a tonic in certain of its forms or states. Lind, who wrote in 1777, advised it in the advanced stages, and about the same time other physicians prescribed it as a prophylactic. Rush, Bayley, and Currie made trial of it in Philadelphia and New York, but abandoned it as decidedly hurtful; while, soon afterwards (1800), two Spanish physicians, Lafuente and Bobadilla, proclaimed it to be a specific when used early in the attack. But the latter opinion having been condemned by the almost unanimous verdict of those who were conversant with the subject, the medicine, when used at all, was prescribed only in cases marked by unusual debility and depression at the commencement of the attack, or as a tonic during convalescence.

After the introduction of sulphate of quinia into medical practice, the hope was entertained that it would accomplish what cinchona had failed to do, on account, as was imagined, of the greater bulk and the nauseous taste of the latter. As early as 1826, Lefort, a physician of Martinique, was induced, by the resemblance which he fancied to exist, as many more had done, between yellow fever and periodical fevers, to treat the former with quinia. He regarded the experiment as successful. Yet the results which he obtained do not seem to have tempted others to imitate his method, for it was not until 1837 that it was proposed as a specific by Thévenot, of Guadaloupe (who, however, fell a victim to the disease), and by Dr. Blair, of Demerara. Quinia was about the same time brought forward in the same character by Dr. Harrison, of New Orleans. He was enchanted by its apparent success: "The fever," he writes, "was in most cases cut short as if by enchantment." But he adds that, nevertheless, patients sometimes died of black vomit after the arrest of the fever, and without having presented a single symptom of the disease in the interval.[1] In the epidemics of 1837 and 1839, at New Orleans, it appears to have been serviceable. During the former the practice of giving it in large doses was inaugurated about the same time as in Demerara. This method was, perhaps, suggested by the ordinary practice of American physicians in periodical fevers, which was also pursued and systematized by Maillot in the treatment of such affections in Algeria. The method was introduced by Dr. Hunt, and extensively employed by Dr. Mackie, then physician to the Charity Hospital of New Orleans.[2] Several physicians of that city, particularly Drs. Harrison and Fenner, were enthusiastic in their praise of a treatment which they now ventured to call *abortive*, and which consisted in the administration of twenty or thirty grains of quinia at a single dose, associated with opium or morphia. In the epidemic of 1837 and 1839 it appears to have been serviceable, but in that of 1841, which was of an inflammatory type, its utility was absolutely null. From 1847 to 1853 Dr. Fenner found that he was able to cut short and cure the fever by large doses

[1] Bell's Bulletin of Med. Sci., iv 20.
[2] La Roche on Yellow Fever, ii. 716.

of quinia at the outset; but the type of the disease so readily mastered was mild. In the graver epidemic of the last-named year, Dr. Fenner again made use of the same treatment, but he remarks, "Candor requires me to state that this abortive practice did not answer my expectations, and, after giving it a fair trial, I abandoned it, and fell upon a milder course of treatment, which proved more satisfactory."[1] At the very time when this conclusion was reluctantly arrived at in New Orleans, Dr. Anderson, of Mobile, describing the treatment employed by the physicians of that city, employed these confident terms: "They used quinine in almost every case, regardless of age, sex, idiosyncrasy, or any other circumstance. They have every reason to be pleased with their manner of treatment, and with their present experience, would not exchange it for any other that they have heard of. The marked and almost magical effect of a large dose of quinine at the outset was so apparent, that they would have considered it little short of trifling with human life to have adopted any other treatment." On the other hand, Dr. W. H. Van Buren, in his report on the use of quinia in Florida, states that he never saw "any decided and permanent good effects from its use in yellow fever, though it was prescribed in doses of every size in a number of cases in the autumn of 1841."[2]

Dr. Warren Stone, of New Orleans, whose experience in the treatment of yellow fever was probably greater than that of any man living, regarded quinia of the utmost advantage, provided it was given at the outset of the disease, just as the rigor has passed off. It then relieves the neuralgic pains, promotes perspiration, prolongs the sweating stage, and thereby often terminates the hot and sweating stages together.[3]

These conflicting opinions and discordant results, taken in connection with other and more particular accounts, will not allow us to draw any conclusions more positive than these: 1. That quinia is not a specific for yellow fever as it is for periodical fevers of every type. 2. That in mild cases which would probably recover under good nursing and an expectant treatment, the medicine may sometimes hasten recovery. 3. That, on the whole, the results depending upon quinia are no better than, if, indeed, they are as good as, those of the treatment of symptoms sanctioned by general experience, and which the skill of the physician must modify to suit the genius of each epidemic of the disease.

Other Malarial Periodical Affections.—To all who observe disease in malarious regions no phenomenon is more familiar than the assumption of the periodical type by all forms of acute and by some even of chronic disease. Inflammations of internal organs undergo such exacerbations and remissions as are not witnessed elsewhere, the latter indeed being sometimes so decided that each paroxysm presents the phenomena of a new attack of the disease, while the intervening periods seem to be almost entirely free from indications

[1] Trans. Am. Med. Assoc., vii. 545. [2] New York Journ. of Med., vi. 79.
[3] Medical Record, Oct. 1867, p. 364.

of its presence. Pneumonia and dysentery frequently display this peculiarity. Nor is it always the case that the one or the other of these diseases, or some other liable to similar revolutions, really exists as the primary and most important affection to which a malarious periodical type is superadded; it sometimes appears, on the contrary, as if the local and apparently inflammatory phenomena were directly excited by the miasmatic poison and obeyed the laws of periodicity like the nervous and circulatory disturbances which characterize the ordinary paroxysms of periodical fevers. The contrast between the violence of the symptoms during the exacerbation and their quiescence or their seeming absence in the apyrexia or remission, certainly tends to mislead the judgment and to cause essential evidences of the morbid process during the latter period to be overlooked. However this may be, there can be no doubt that cinchona is the appropriate and the only appropriate successful remedy for such affections. Under the influence of large doses of quinia the phenomena of the attack subside and disappear, as if the medicine had neutralized some material poison or antagonized some peculiar morbid force in the system. A clear perception of the truths which have been here briefly alluded to forms an essential preparation for the treatment of all diseases occurring in places where periodical affections prevail; and, even elsewhere, the occasional periodicity of other morbid phenomena than those pertaining to the nervous system points to the fitness of the same method of treatment.

Diseases of the Nervous System. Neuroses.—In all functional diseases of the nervous system, a tendency to the occurrence of periodical exacerbations is at times observed, and sometimes they present paroxysms not less distinct and regular than those of intermittent fever. This periodicity, although it is most regular when it results from malarial poisoning, is nevertheless observed in localities where no causes of miasm exist and no form of true intermittent fever ever originated. In some cases, especially those first referred to, in which the influence of malarial poisoning may be suspected, the attacks yield to comparatively small doses of quinia, without the aid of other medicine. In others, which are associated with and probably dependent on debility of the system, and especially upon an anæmic condition, quinia is comparatively ineffectual, while bark in substance or in extract insures recovery by means of its tonic and reconstituent power. In others, again, the disease is a purely nervous derangement, paroxysmal rather than periodical, and curable, if at all by quinia, only by large and sedative doses of this medicine.

It has been found that quinia acts least favorably, as a general rule, upon nervous affections which originate in the brain, or which affect the organs of the special senses, owing probably to the congestion of these organs, which it induces or aggravates. On the other hand, in attacks of spasmodic asthma, and of convulsive cough attending bronchitis, such as occurs during epidemics of influenza, it possesses unquestionable powers. In Kopp's asthma, or

laryngismus stridulus, M. Merei states that he found its effects equally rapid and satisfactory in about one-half of a dozen cases for which he employed it. The cases in which it was prescribed by him were those of weak and obviously nervous infants, suffering for weeks or months from fits, but during the intervals free from all disease. For infants from four to six months old he directed doses of nearly one grain of quinia every second hour, until the physiological action of the drug was manifested.[1] In periodical *palpitations* of the heart, M. Briquet states that this remedy exerts peculiar efficacy. *Hiccup*, it is well known, is sometimes exceedingly obstinate, and cases of its fatal termination have been recorded. In one instance, after the failure of nearly every narcotic and antispasmodic medicine, and when it was evident that life would soon terminate, a dose of twelve grains of sulphate of quinia brought the attack to a conclusion within three hours.[2]

In more general forms of nervous convulsion, bark is less successful. Such is the case with *epilepsy*. Tissot, and also Torti, relate instances of its success, but they appear to have been examples of intermittent fever with epileptiform paroxysms, rather than true epilepsy. Indeed, this explanation is suggested by Torti himself regarding a case which he relates.[3] A similar example was reported by M. Hippeau in 1822,[4] and since the introduction of quinia, several more may be added to the number. Thus, M. Mazade published a case which occurred during an epidemic of intermittent fever, and which was treated at first in daily doses of eight grains, and afterwards of fifteen grains of quinia and upwards. Several relapses occurred, but a permanent cure was at length effected.[5] In another case, quoted by M. Briquet from Taroni, the disease was produced by fright, and was cured after a treatment of three months.

The effects of the remedy in *tetanus*, chiefly but not exclusively of the idiopathic form, are more favorable. In a case of traumatic tetanus, reported by Dr. Malone, of Florida, the recovery of the patient is ascribed to quinia, given at first to the extent of fifteen grains, in three doses, at intervals of two hours, and then continued in doses of three grains every three hours. Ringing in the ears, and partial deafness, attested the operation of the remedy.[6] Other successful cases are reported by Drs. Bishop, of Ithaca, New York,[7] Firna, of Milan,[8] Gleizes,[9] Cock,[10] Coste,[11] Dr. G. O. Rees,[12] and Mr. H. Walton.[13] Several cases are also referred to by M. Briquet.[14]

Neuralgia.—This disease is essentially paroxysmal, and is sometimes regularly intermittent, quite independently of a miasmatic

[1] Month. Journ. of Med. Sci., Nov. 1850, p. 463.
[2] Bull. de Thér., lxiii. p. 326.
[3] Therapeutice Specialis, p. 426.
[4] Delasiauve, Traité d'Epilepsie, p. 378.
[5] Bulletin de l'Acad. de Méd., xiii. 849.
[6] Am. Journ. of Med. Sci., Oct. 1843, p. 376.
[7] N. Y. Journ. of Med., ix. 201.
[8] Archives Gén., 4ème sér., vi. 76.
[9] Abeille Méd., xiv. 91.
[10] Lancet, June 28th, 1851.
[11] Ibid., July 5th, 1851.
[12] Times and Gaz., June, 1857, p. 644.
[13] Ibid., Nov. 1868, p. 558.
[14] Op. cit., p. 492.

cause. In proportion to its assuming the latter type is it curable by quinia; but the medicine must generally be given in large doses. From ten to twenty grains administered six or eight hours before the paroxysm, in divided doses, is usually required. Its efficacy is increased by opium.

As early as 1822, periodical neuralgia of the fifth pair was cured with sulphate of quinia by Piedagnel, Dupré, and Ribes. In 1834, Dr. W. A. Gillespie, of Virginia, published two cases of severe miasmatic neuralgia occupying the dental branches of the fifth pair, and cured by the same remedy.[1] A similar case is reported by Nepple,[2] and one of great severity, affecting the same nerve, in a female exhausted by lactation and loss of rest, was cured by Mr. Hogg, with doses of from ten to fifteen grains of quinia, given until deafness ensued. Many other remedies had been tried in vain.[3] Other forms of neuralgia have also been found amenable to the power of this medicine. A case of femoro-popliteal neuralgia was cured by Dupré with quinia after depletion, revulsives, and opiates had failed to give relief.[4] Mondière cured, by its means, neuralgia of the uterus;[5] and Brachet, a case of severe urethralgia of long standing, and of an imperfectly intermittent type.[6] Sir B. Brodie cured one in which neuralgia of the inferior dorsal nerves occurred paroxysmally at night, by means of sulphate of quinia taken daily to the extent of thirty grains.[7] Numerous examples of the efficacy of this medicine in neuralgia of the ulnar, sciatic, crural, and other nerves, are given by Dr. Handfield Jones.[8] In all of these cases various other remedies had been employed, such as narcotics, iron, stimulant embrocations, and blisters; but the degree of improvement was evidently dependent more upon the quinia than upon all the other means together, in proportion as the disease assumed the periodical type. The subcutaneous injection of quinia for this disease has been used successfully by Dr. W. H. Draper.[9]

Intermittent Paralysis. — Intermittent paralysis occurs in two forms; as one of the phenomena of a paroxysm of intermittent fever, and as an uncomplicated affection depending, however, upon malarial causes. The former, perhaps, is most frequently met with. M. Mazade has given an account of a case of each variety; in both instances the disease assumed the form of hemiplegia, in the one case quotidian and in the other tertian. Both yielded promptly to full doses of quinia.[10] In another more recent case, the type of the attack was double tertian, and the paralysis, which was general, involved both sensation and motion. A dose of ten grains of sulphate of quinia, followed, the next day, by one of twelve grains,

[1] Am. Journ. of Med. Sci., May, 1834, p. 115.
[2] F. Cuvier, Thèse de Concours, 1838.
[3] Lancet, Nov. 1850, p. 575.
[4] Philada. Journ. of Med., v. 436.
[5] Archives Gén., 2ème sér. (1835), vii.
[6] Abeille Méd., xiv. 201.
[7] Essay on Local Nervous Affections (1837), p. 28.
[8] Lancet, June, 1855, p. 577, and p. 603.
[9] Med. Record, ii. 393.
[10] Bull. de l'Acad., xiii. 850.

put an end to the attack.[1] A striking example of intermittent hemiplegia, which was cured by the same means, is related by M. Bonnet.[2] A case of intermittent *aphonia* affecting a pregnant woman, and recurring for six successive days, at the same hour, was cured by Heusinger, by five grains of sulphate of quinia in one dose.[3]

Delirium Tremens.—Houssard states that he used with the happiest effects in this affection, and for the tremulousness which affects habitual drunkards, a strong infusion of cinchona.[4] M. J. Guérin adds to this statement his observation, that an infusion of cinchona prevents the intoxicating effects of wine to a remarkable degree,[5] a fact which can probably be explained by the action of the tannin of the bark. It is well known that astringent are much less intoxicating than sweet wines.

Heat Apoplexy or Sunstroke.—Although the pathology of this affection has of late formed the subject of numerous investigations both at home and abroad, the conclusions arrived at regarding the nature of the affection do not appear to have suggested to any one the appropriateness of quinia as a remedy for it. Yet if the observations of Mr. Waller[6] should be confirmed, quinia will certainly prove to be the most efficient remedy in this dangerous disease. Mr. Waller considered it a specific whether the skin is hot and dry, or cool and moist, and whether or not muscular spasm be present. He gave the quinia by the mouth, or, if the patients were unable to swallow, hypodermically, and at every stage of the attack; in the former case in the dose of twenty grains at first, and of ten grains every successive hour; in the latter case a grain and a half was injected in each arm. The effect was to rapidly diminish the stupor, and spasm if it existed; to restore the consciousness, and, in a word, to cure the attack. The results of this method appear to have been as favorable as possible, for, as Mr. Waller remarks, "in India the mortality from heat apoplexy is more than fifty per cent., while by the treatment by quinia the success so far has been constant."

Acute Articular Rheumatism.—Under an impression that this disease, which is so remarkable for its remissions and exacerbations, might yield to the same remedy as intermittent and remittent fevers, Peruvian bark was employed in its cure by Morton, and with such success as to induce other physicians to imitate his example. Among these was Fothergill, who describes a form of rheumatism which attacked children particularly, was very much disposed to migrate from joint to joint, and had regular evening exacerbations and morning remissions. A decoction of bark, with rhubarb sufficient to keep the bowels open, commonly removed the disorder in a few days with great certainty.[7] But the most con-

[1] Gazette Méd. de Toulouse, and Abeille Méd., x. 215.
[2] Bull. de Thér., lxxviii. 39.
[3] Deutsche Klinik, No. 39, 1859.
[4] Bull. de l'Acad., xxviii. 57.
[5] Bull. de Thérap., lxiv. 88.
[6] India Med. Gaz., July, 1869.
[7] WILLAN'S Miscell. Works, p. 262.

spicuous advocate of this treatment was Haygarth, who learned it from Fothergill, and, like him and Morton, adopted it on the ground of supposed "analogies between an ague and a rheumatic fever." Haygarth made use of it habitually and with great satisfaction for a period of thirty-five years. He insisted on the necessity of prefacing its administration with "sufficient evacuations of the bloodvessels, stomach, and bowels," as well as with sudorifics and the warm bath in certain cases. This preparation he held to be essential, and if, owing to its insufficiency, the bark disagreed, the latter was suspended, and depletion and evacuants were employed anew. Bark was prescribed by him in doses of from five to fifteen grains, gradually increased to twenty, thirty, or forty grains every two, three, or four hours. Under its use the pain, swelling, sweats, etc., abated speedily, and the cure was generally perfected without any permanent enlargement of the joints, or other disability.[1] The careful preparation of the patients by means of evacuant medicines will be here particularly noticed, for, doubtless, it is owing to a neglect of this precaution that many later observers have failed to obtain from bark the benefits described by Haygarth.[2] Cullen, for example, seldom found it useful, and in some cases hurtful. It appeared to him to be fitted for those cases only in which "the phlogistic diathesis is already much abated," and where, at the same time, the exacerbations are manifestly periodical.[3] Several recent observers, who have pursued the method of Haygarth, have obtained similar results. Thus Dr. D. D. Davis declared bark to be "the most powerful remedy that can be employed," provided the acute stage be combated by means of evacuants, first, free depletion and then an emetic, followed by a purge of calomel and jalap, and, if necessary, local bloodletting. He prescribed the bark in doses of from twenty to thirty grains three or four times a day.[4] Mr. Popham states that in acute rheumatism, unattended with effusion in the joints, and after the due employment of evacuants, "it prevents relapse or loss of strength, and those unruly aches and pains that so often survive the original attack."[5] Perhaps the only writer of authority who entirely condemns this method in the cases indicated by Haygarth, while professing to have conformed to his precepts, is Scudamore, who says: "I have repeatedly followed his authority in administering the bark in the first stage of the acute rheumatism, its use having been premised by due evacuations; but I do not remember more than one case in which I found it successful. *A priori*, we could not expect it to be a medicine otherwise than injurious when a

[1] A Clinical History of Diseases, 1805, p. 45, etc.

[2] He describes them in these words: "Except mercury in syphilis, there are few or perhaps no examples where a remedy can produce such speedy relief and speedy recovery in so formidable a disease. For many years I have been thoroughly convinced that the Peruvian bark has a much more powerful effect in the rheumatic than any other fever, and that it does not even cure an ague so certainly and so quickly."

[3] Mat. Med., ii. 96.

[4] Lancet, Jan. 1841, p. 572 and p. 718.

[5] Dublin Quart. Journ., Sept. 1845, p. 59.

sympathetic inflammatory fever is present, and all the secretions except that of the skin, which is irregular, are more or less impeded."[1] It is probable that the *à priori* views of Sir Charles prevented him from clearly discerning the truth. His objections are adapted to provoke the criticism passed upon those of Parry by Dr. Copland, who says concerning them: "They can have no weight when duly examined by the physician who has had any experience of the operation of this medicine in acute rheumatism."[2] Dr. Copland states that since 1819 he always employed cinchona for that disease as early in the attack as possible, after due evacuations.

Since the introduction of *quinia* into practice, it has supplanted bark in the treatment of rheumatism, and with as inferior results as in several other diseases. It has, however, been administered in two different manners, in small doses as a substitute for bark, and in large doses as a sedative. By the former method it has entirely failed of its purpose, because it is not an equivalent of bark. This comparative ill success is amply set forth by Dr. Fuller,[3] who insists that quinia should not be administered at all until the pulse becomes soft, the tongue moist, and the urine clear. He has, however, found it of essential service in cachectic states of the system, or when the patient has been exhausted by the attack.

The use of quinia in large doses, as a sedative, was commenced in 1842 by M. Briquet, to whom belongs the introduction of this method. Between the date mentioned and 1853, he treated two hundred and fifty cases of acute and chronic articular rheumatism by means of large doses of quinia. That is to say, beginning with from sixty to seventy-five grains a day, in divided doses, he reduced the quantity to forty-five, thirty, or even fifteen grains a day, according as its specific effects were induced. No other treatment was, in general, employed. This method was found less efficacious in highly inflammatory cases, and most so, on the other hand, in persons of a lymphatic constitution, and debilitated by previous disease, or by the antiphlogistic treatment carried to an extreme. When many joints were involved, the disease yielded more readily than when it was confined to a single one. M. Briquet is persuaded that under this plan of treatment the disease is cured in less time, and with less loss of strength, and consequently is followed with a more rapid convalescence, than when other methods are employed. The patients also suffer less pain, and therefore do not lose their rest so much at night. On the whole, M. Briquet believes that the exclusive treatment by quinia is the most efficient in shortening the attack, in sparing the strength, and diminishing the sufferings of rheumatic patients.

These conclusions are not fully sustained by other physicians who have made use of the same method. M. Monneret,[4] for ex-

[1] On Gout and Rheumatism, 3d ed., p. 665.
[2] Dict. of Pract. Med. (Am. ed.), iii. 687.
[3] On Rheumatism (Am. ed.), p. 88.
[4] Journ. de Méd. (1844), ii. 18. Compend. de Méd. Prat., vii. 389.

ample, employed the treatment by quinia in twenty-two cases of articular rheumatism, giving from thirty to ninety grains of the medicine daily, and for an average period of ten days; but in only seven was the treatment completely successful, and in only three of these was the attack severe. He found, like M. Briquet, that whenever the disease tended to fix itself upon a joint the plan was unsuccessful, and, also, at the commencement of an attack when the local or general symptoms were severe. He also noticed that, like opium, the medicine appeared often merely to disguise the pain, for it returned upon the suspension of the treatment. Indeed, this facility of relapse is visible in the accounts published by M. Briquet himself, and M. Grisolle says of relapses that they occur oftener and perhaps more readily after this than after any other form of treatment.[1] M. Legroux has also published the results which he obtained by means of the treatment with quinia.[2] But he administered it in smaller doses, not exceeding thirty grains a day, and generally gave even less than this. He reports that nineteen out of twenty-four cases were completely cured under the influence of quinia, but admits that a relapse occurred in five cases. It is of still more consequence to observe that in many cases he made use of bleeding, sometimes as often as three times in the same attack, and, besides this, purgatives and blisters. M. Vinet, who published numerous examples of rheumatism treated by sedative doses of quinia,[3] found that very often this medicine was, of itself, inadequate to the cure. While asserting that it, on the whole, exerts a decided influence upon the disease, and that in one-half of the cases the action is prompt and permanent, he admits that in the other half it is slow and uncertain, or even null. Like the other writers cited above, he also states that it has no tendency to prevent relapses.

The method of M. Briquet does not appear to have been much imitated elsewhere than in France. Dr. Bence Jones says, concerning a single trial of it which he made, giving as much as one hundred grains of quinia to the patient in twenty-four hours, that no alteration was made in the pulse, no effect was produced on the pain, nor on the swelling of the joints, and on the third day he was obliged to discontinue the treatment on account of the sickness which ensued.[4]

It will have been remarked that M. Legroux employed quinia as an adjuvant merely, or to complete the cure commenced by antiphlogistic measures, or in much the same manner as Haygarth prescribed bark; and to this may probably be attributed his comparatively good success. But that success was less than what Haygarth himself could boast of. Indeed, on weighing carefully the whole matter, we are forcibly struck with the great superiority of the original method, and are persuaded that bark, in substance or in

[1] Pathologie interne, 7ème éd., ii. 873.
[2] Journ. de Méd. (1845), iii. 10.
[3] Archives de Gen., 4ème sér., xvii. 106.
[4] Times and Gazette, June, 1855, p. 565.

extract, would still be found a potent remedy for acute rheumatism of the diffused form, if its administration followed the use of sudorifics, diuretics, and purgatives, but that no special advantage is to be derived from the use either of bark or quinia, in rheumatism, unless these precautions are observed.

In *chronic rheumatism* the use of bark is indicated whenever the system is enfeebled, the perspiration excesssive, and, above all, when the disease is not confined to one or two joints. But even then the medicine will powerfully contribute to the success of such local measures as are appropriate.

In *gout* cinchona has been used for a long time. As early as 1714, Held proclaimed it to be a "divine remedy" for this affection; but Cullen, and after him Scudamore, limited its employment to the intervals between the attacks, to strengthen the digestion, and ward off a return of the disease. Quinia has been used for its sedative property in large doses, during the paroxysm, but it has had no success to recommend it, and the danger of excessive sedation in a disease which may so readily abandon its original seat to attack the essential organs of life, cannot be too strongly insisted upon.

Typhus Fever.—It was formerly a universal custom to administer cinchona, in substance, decoction, or extract, in the advanced stage of typhus fever, and, generally, to combat the typhoid state. This state is characterized by great prostration, a languid cutaneous circulation, petechiæ, a foul and dry tongue, muttering delirium, stupor, and subsultus tendinum. When such symptoms exist, there can be no doubt that alcoholic and medicinal stimulants and nutritious food become essential to the patient's safety. Originally, this condition was imagined to be analogous to putridity, and the diseases in which it occurred were called putrid, *e. g.* putrid fever, or typhus. Because Peruvian bark limited putrefaction in decaying animal matter, it was at once inferred to be a specific for the hypothetical putrefaction of disease. It would have been more rational, on such grounds, to administer tannic acid, or corrosive sublimate, or arsenic. But hypotheses and reason, in medicine at least, have little in common. In course of time, when it was found that, whatever virtues bark displayed in the typhoid state, they were greatly exceeded by those of quinia, which is not an antiseptic; and when the action of this alkaloid on the nervous system had been demonstrated, it became evident that quinia acted beneficially in such diseases after the same manner as alcohol and other stimulants, by maintaining it in efficient operation until the poison itself and the degraded tissue it created, had been eliminated from the system.

The first preparation of bark which acquired general reputation in typhus fever was one in which it was associated with other stimulants in alcoholic solution. Such a preparation was originally designed by Huxham, and it to this day is known by his name, and stands among the best officinal medicines. Even Cullen, little partial as he was to stimulant remedies, expresses no doubt

respecting their usefulness. He goes further, and even speaks approvingly of the practice employed by Dr. James, of endeavoring, by means of his antimonial powder, to procure a remission early in the attack, and then under these circumstances employing Peruvian bark. After the introduction of quinia it was substituted for bark itself, and in 1824 we find Dr. O'Brien attempting to demonstrate its efficacy when administered after the stage of excitement had passed.[1]

But quite recently quinia has been used in typhus with a different object. Dr. Dundas, of Liverpool, starting from the singular hypothesis of the identity of the periodical fevers of the tropics with the typhus fever of Great Britain, employed quinia for the cure of the latter disease, in doses of from ten to twelve grains, repeated three or four times, at intervals not exceeding two hours. He asserts that in the great majority of cases of uncomplicated typhus, taken at the commencement, complete and rapid success may be counted upon.[2] Dr. Eddowes, of the Liverpool Fever Hospital, substantially confirmed these statements, as well as Drs. Steele, Gee, Stevenson, Glassbrook, Lister, and Gildersleeves, of the same city; and Mr. Hayward states that he obtained the most beneficial effects from the quinine treatment in seventy-nine cases of fever.[3] Dr. Fletcher, of Manchester, employed this remedy in eighty cases of typhus. "In the majority," he says, "cinchonism established a permanent convalescence within forty-eight hours." Of the cases in which the typhoid character of the disease was prominent before the administration of the remedy, five-sixths were convalescent within fourteen days, and of persons under the age of puberty nine-tenths were cured within the same period.[4] Possibly the fever may have been of an unusually mild type. It is singular, however, that in Edinburgh a very different verdict was pronounced in the matter now before us. Dr. Robertson treated eight cases of typhus according to the directions of Dr. Dundas, but no appreciable good effect was produced; on the contrary the medicine sometimes csused cerebral excitement, followed by coma of a very alarming character.[5] Dr. Bennett also made use of the treatment in seven cases of typhus. "In none of the seven cases," he informs us, "notwithstanding the physiological action of the drug was well marked, did it in any way cut short the disease, or produce, in its progress, so far as I could ascertain, any amelioration whatever."[6] Notwithstanding, therefore, the favorable accounts at first published of this treatment, we cannot discover sufficient grounds for its adoption. Judging also from our own experience in the treatment of typhus fever in several epidemics, we should, as already intimated, employ the medicine, like any other stimulant, to sustain the powers of life when they tend to sink, and in no sense as a specific for the disease.

[1] Trans. Coll. Phys. Ireland, iv. 367. [2] Med. Times, Oct. 1851, p. 346.
[3] Lancet, Oct. 1852. [4] Times and Gaz., April, 1853, p. 422.
[5] Edinb. Month. Journ., July, 1852, p. 91.
[6] Ibid., June, 1852, p. 564.

To expect from it more than this view warrants appears to us as irrational as it is erroneous.

Epidemic meningitis, or cerebro-spinal meningitis, a disease which has prevailed at different periods in this country and in Europe, and been variously entitled cerebral typhus, tetanic or apoplectic typhus, petechial fever, spotted fever, etc., was treated with bark or its preparations on both sides of the Atlantic. Early American writers upon the subject unanimously condemned cinchona, and those of a more recent period who employed sulphate of quinia agree in pronouncing it useless unless a miasmatic complication happen to be present. In Europe all of the most reliable observers of this disease formed the same estimate of quinia in its treatment as physicians in the United States had already formed; indeed, after a careful study of others' experience, and an unusually favorable opportunity for a personal study of the disease, we think that the medicine is entirely useless in combating its essential elements, and is only available, like any other stomachic and nerve tonic, during the stages of decline and convalescence.[1]

Typhoid Fever.—Both Home and Cullen appear to have used bark in a form of fever which was probably the typhoid. The former speaks of it as useful when there is much prostration, with sweating and tremor;[2] but the latter frequently found, as some recent observers have done in the case of quinia, that it aggravated the inflammatory state of the system, and determined fatal inflammation of the brain and of the lungs.[3] From 1840 to 1842 quinia was used as a sedative in typhoid fever by several physicians in Paris, among whom were Blache, Manoury, and Broqua. M. St. Laurens, reporting upon the cases treated at the Hôtel Dieu, states that in doses of from twenty to forty grains it sometimes produced a marked subsidence of the pulse, but that the tongue became redder and drier, the thirst was increased, vomiting occurred, with epigastric pain, and sometimes the diarrhœa was considerable.[4] In 1843, M. Louis presented a report to the Academy of Medicine upon a memoir of M. Broqua, in which the use of large doses of quinia was advocated in typhoid fever. The report concludes with the following resolution, which was adopted by the Academy, viz., that the utility of quinia, according to the method described, is far from having been proven.[5] In an excellent essay by M. Jacquot, published in 1844, eight cases of typhoid fever are reported in which the medicine seems to have controlled the ataxic symptoms and the exacerbations of fever in the second stage of the disease.[6] Much more recently, Dr. Barclay, of London, used the medicine in eighteen cases of typhoid fever, administering it in doses of ten grains every four hours; but with no perceptible advantage.[7] When, in the same year, a memoir was read before the

[1] Stillé on Epidemic Meningitis, p. 158.
[2] Clinical Exper., p. 13.
[3] Works, i. 641.
[4] Archives Gén., 3ème sér., xv. 5.
[5] Bull. de l'Acad., viii. 624.
[6] Archives Gén., 4ème ser., vi. 85.
[7] Times and Gaz., Jan. 1853, p. 31.

French Academy of Medicine, advocating this treatment, an earnest protest was made by Dr. Conté, who had witnessed its disastrous effects.[1] Dr. Peacock, who examined the question carefully, found that under the quinia treatment the rate of mortality was increased, and the residence of the patients in the hospital prolonged.[2] A special method of administering the medicine was advocated by Dr. Worms, of Paris. It consisted in giving an antimonial emetic in the forming stage of the attack, followed by a twelve-grain dose of quinia. In the active period of the disease two doses of nine grains each were prescribed with an interval of seven or eight hours, and this prescription was repeated the following day. Thereafter the medicine was administered in gradually diminishing doses. Dr. W. alleged that by this plan the attack is often terminated in from five to eight days.[3] The treatment has, on the one hand, found an enthusiastic advocate in Dr. Leclerc,[4] but, on the other, has been stigmatized as incendiary by Dr. Petit,[5] and admitted by one of its advocates, Dr. Florentin,[6] to produce intestinal irritation of an alarming nature and even fatal issue. Finally, Dr. Mazade, who employed both large and moderate doses of quinia in this affection, observed very alarming consequences after the administration of the former, and no marked benefit from the latter, unless the disease assumed a periodical type.[7]

With this testimony before him, the reader will be better able to affix a just value to the conclusions of M. Briquet, the most earnest advocate of the treatment in question. He prescribed the medicine in doses of from fifteen to twenty-two grains a day in mild cases; in severe cases from twenty-two to thirty grains were given, and in grave cases from forty-five to sixty grains. He claims, and it cannot be denied, that the fever, as indicated by the state of the pulse and skin, subsides under the operation of quinia. The pulse falls, on an average, from 96 to 70 after five days' use of the medicine in mild cases; and in those of a grave type from 98 to 75 in the course of two days. The nervous symptoms are in like manner palliated when they are ataxic, consisting of headache, titubation, agitation, and delirium, while the eye is bright and the face injected; they are augmented in the adynamic form with prostration, stupor, a dorsal decubitus, and a constant tendency to sleep or to coma. The irritant action of the medicine upon the intestinal canal is represented as being very limited. Yet it is urged as an important precept never to continue the quinia in large doses for more than a week at a time; and three cases are referred to, in one of which, gangrenous ulceration was found in the large intestine, and in two others an unusual degree of inflammation. In regard to the mortality in cases treated by quinia, it is admitted

[1] Le danger de la sulfate de quinine dans le traitement des fièvres typhoides. Paris, 1857.
[2] Times and Gaz., Jan. 1856, pp. 3, 38, 55.
[3] Abeille Méd., xiii. 211.
[4] Ibid., pp. 321, 331.
[5] Ibid., p. 241.
[6] Ibid., xiv. 21.
[7] Bull. de Thérap., lxvi. 193.

to be not less than the general average by other methods. On the whole this author concludes, that the quinia treatment is not one adapted for general and ordinary use in typhoid fever. It is suited only to certain determinate cases, and, perhaps, to particular epidemics; and in general, like most other remedies, ought only to be made use of to combat certain forms of the disease, or certain predominant symptoms.

From the foregoing summary of opinions and results derived from those who regard with partiality the treatment of typhoid fever with quinia, and from those whose experiments in its use have led them to condemn it, it is, we apprehend, abundantly clear that the remedy is one of secondary value, if, indeed, it possesses any virtues at all, in this disease. In small doses no peculiar benefits are claimed to proceed from it, and in large doses the hazards of its administration greatly outweigh its occasional usefulness.

In the *typhoid fever of children*, MM. Rilliet and Barthez administered quinia in divided doses amounting to about seven grains a day, and continued them for a period of from seven to fourteen days. They found it to diminish the frequency and fulness of the pulse, and the heat of skin, perspiration, and desquamation of the cuticle, while it increased the muscular strength. It did not occasion dryness of the mouth, nor, in the fatal cases, any irritation of the stomach.[1] But there is nothing to show that the disease would not have been as quickly cured and as safely treated by other means which would have spared the necessity of administering a medicine repugnant to the patients and of high price.

Quinia has been used by Prof. Retzius to prevent *puerperal fever*. During the prevalence of an epidemic of this disease in the Lying-in Hospital of Stockholm, he caused all of his patients for some time before their confinement to take a scruple of sulphate of quinia every day. He was of opinion that this measure contributed powerfully to stay the progress of the epidemic.[2]

In *smallpox* of a malignant type Peruvian bark was once strongly recommended as an alexipharmic and anti-putrescent remedy; and Monro was induced by its success in gangrene to use it in those typhoid forms of variola in which the pustules do not fill or when petechiæ appear.[3] In the same disease Cullen prescribed it to repair loss of strength, and correct "a putrescent tendency of the fluids."[4] Bardsley used quinia under the same circumstances in children, and with advantage,[5] and Rilliet and Barthez mention a case of hemorrhagic variola which would have almost necessarily been fatal but for the administration of sulphate of quinia in doses of about six grains a day for ten days, given in divided portions.[6] In 1857 Dr. Hood, of London, and one or two others, recommended quinia in *scarlet fever*. Dr. H. held it to be "the sheet anchor of successful practice" in this disease, after a due administration of

[1] Archives Gén., 3ème sér., xi. 187.
[2] Edinb. Month. Journ., Sep. 1851, p. 279.
[3] Edinb. Med. Ess. and Obs., v. 87.
[4] Works, ii. 164.
[5] Op. cit., p. 142.
[6] Mal. des Enfants, 2ème éd., iii. 101.

purgatives. We are not acquainted with any authoritative corroboration of this statement.

Erysipelas.—Under the novel impression of the discovery that inflammation is accompanied by a migration of the white corpuscles of the blood through the walls of the vessels, and that quinia limits this migration in a remarkable degree; and still further, that in erysipelas the ordinary swelling of the affected part is due to this transudation, and that in phlegmonous erysipelas the pus merely represents the transuded white corpuscles, it has been proposed to administer quinia for the cure of erysipelas. We have no doubt of its utility, and have long used it both along with the tincture of chloride of iron and before that preparation was employed for the cure of the disease. We have used it as bark was prescribed by Hoffmann, Heberden, Fordyce, Pearson, Cooper, and many others, to control a tendency towards the typhoid state so characteristic of erysipelas. Whether it does so in the manner implied by the theory which has been referred to, matters little if the fact of its efficacy be established. We have no doubt that it is efficient when the medicine is administered under the circumstances indicated, and not merely as an antidote to erysipelas, which it is not.

In certain forms of *scrofula* cinchona has always been considered a valuable remedy. Fordyce recommended it when the blood is impoverished, and when the solids are flaccid, the glands enlarged, or the eyes inflamed.[1] Fothergill found it highly beneficial in similar cases to these, but useless when the bones were affected or the joints,[2] and, in our own time, Lebert pronounced powdered bark in large doses the best remedy for scrofulous ulcers and abscesses.[3] In an affection of the *eye*, attended primarily with amaurotic symptoms, and afterwards with those of chronic inflammation of the iris and cornea, Mr. Wallace, of Dublin, found bark and quinia the most efficient agents of cure.[4] Dr. Mackenzie pronounces the use of sulphate of quinia an improvement in ophthalmic medicine perhaps scarcely less important than the treatment of iritis with mercury. After a trial of numerous remedies for *phlyctenular ophthalmia*, he found none so useful as this; in scrofulous *keratitis* the remedy, although slower in its operation, was not less beneficial; and in chronic scrofulous *iritis* with intolerance of light, smallness of the pupil, dulness or discoloration of the iris, with zonular redness, *without effused lymph*, mercury, he says, is not called for, and quinia is more likely to do good.[5] Mr. Middlemore also found quinia of signal service under circumstances similar to the above.[6]

Although bark cannot cure tubercular *phthisis*, nor even *chronic bronchitis*, yet there are states of both diseases in which it may become very serviceable. These exist when there is a rapid wasting of the system under the influence of profuse expectoration and

[1] Med. Obs. and Inq., i. 184.
[2] Works, ii. 16.
[3] Maladies Scrophuleuses, p. 302.
[4] Med.-Chirurg. Trans., xiv. 297.
[5] Diseases of the Eye, 2d ed., pp. 390, 460, 493, and 524.
[6] Lond. Med. Gaz., July, 1831, p. 545.

night-sweats. The acidulated cold infusion of bark often tends materially to lessen these discharges as well as directly to improve the strength. Cullen found bark most useful in cases of *hectic fever* in which the morning remissions and evening exacerbations were most distinctly marked. It often suspended the paroxysms for a considerable time. When the sweats result from debility alone, the benefit is more permanent. Such is the case during convalescence from many acute diseases, after unduly prolonged lactation, etc. It is equally beneficial in cases of great susceptibility to catching cold in consequence of a languid circulation and an impoverished state of the blood. Indeed there is hardly any *asthenic* form of disease in which it is not applicable. Dr. Corrigan has strongly recommended quinia for this form of *pneumonia*, in doses of five grains every three hours,[1] and Dr. Gordon found the same treatment successful in similar cases which he regards, no doubt correctly, as examples of vascular engorgement rather than inflammation of the lung. Although diffusible stimulants acted favorably upon the symptoms, they were less efficient than quinia.[2]

The state of muscular debility and nervous excitability which often occurs during the second stage of *whooping-cough* is almost always improved under the influence of quinia, or, still better, of bark. Cullen thought that it seldom failed to cure, and it has been spoken of favorably by Trousseau, Barrier, Rees, Johnson, and Copland, in cases where the paroxysms tend to assume the periodical type, or when the general state of the patient calls for tonic treatment.[3]

Dr. Macfarlan, of Williamsburg, N. Y., claims for quinia a power of curing "*croup*," and gives it the preference over nitrate of silver, emetics, and calomel. In support of his opinion he has published four cases,[4] of which one was a case of laryngeal spasm produced by a fungus of the trachea, which afterwards proved fatal, and the other three were clearly examples of *spasmodic laryngitis*, which would certainly have got well even without the use of sulphate of quinia in doses of from one-third of a grain to one grain every half hour.

In several diseases of the *digestive organs* bark or quinia may be of signal service. M. Hervieux has reported a rare and curious case of *mucous flux* from the pharynx which offered a daily remission or suspension, and was cured by means of sulphate of quinia.[5] In *atonic dyspepsia* these medicines are sometimes beneficial, but less so than simple vegetable bitters, on account of the astringent and irritant operation of the former. They are most appropriate in cases where the gastric atony is shared by the system generally. In epidemic *dysentery* at an advanced stage of the disease, or when those adynamic symptoms appear which denote disorganization of

[1] Am. Journ. of Med. Sci., Oct. 1856, p. 486.
[2] Dublin Quart. Journ. of Med., Aug. 1856, p. 103.
[3] Gibbs on Whooping-Cough, p. 308.
[4] New York Journ. of Med., N. S., xiii. 364. [5] Bulletin de Thérap., i. 442.

the blood, bark is often of great service, especially in hot climates. In chronic dysentery quinia, by its tonic influence, may co-operate with other remedies to promote the restoration of the diseased mucous membrane of the colon to its normal condition. In many other cases in which a mucous membrane is the seat of a chronic discharge, as in affections of the *bronchia*, and of the *genito-urinary organs*, and even in *chronic abscesses* opening externally and secreting a strumous liquid, the administration of quinia, or, still better, of bark, is often attended with the best results.

The principle established by the success of iron in the treatment of *scarlatinous dropsy*, is well illustrated by the beneficial influence of quinia in the same disease. Impressed with the inefficacy, if not the injurious effects of sedative measures in this affection, Hamburger[1] resolved to test the influence of quinia upon it. The medicine was administered in forty-seven severe cases. In forty-four of them improvement took place within a few days, if not immediately, and in three cases the action of the medicine was not so apparent, but the patients recovered. Under its use the fever of the acute stage subsided, and the urine became more abundant and less dark and bloody. The albumen did not so rapidly diminish, but the patients became rapidly convalescent without any bad symptom or consecutive relapse. The quantity of quinia daily given to children was from one to two grains, and to adults from three to five grains, in divided doses. A case is recorded in which acute dropsy with *albuminuria* in an adult female seems to have been cured by sulphate of quinia in doses of one grain five times a day, along with alkaline mineral waters and purgatives.[2]

Various bitter substances have been used successfully as *anthelmintics*, such as quassia, absinth, and gentian. Cinchona was recommended as a vermifuge in the last century; but more recently M. Delvaux, of Brussels, employed it and also the sulphate of quinia. He states that in more than forty cases he expelled lumbrici by its use, and cured two cases of tænia. Yet he gave it in only one or two grain doses repeated four times a day. He also found enemata containing quinia effectual remedies for *oxyures vermiculares*.[3]

Gangrene, both spontaneous and traumatic, has occasionally been arrested by the use of bark. In *scurvy* it has always been regarded as having peculiar virtues due to its combined tonic and astringent operation. It was long ago believed to have great value in various forms of passive *hemorrhage*, and especially of hemorrhages from ulcerated surfaces. The special indication for its use is impoverishment of the system, on the one hand, and the occurrence of the loss of blood at regular intervals. Cullen advised it in *menorrhagia* of this sort, or, as he expressed it, depending on "laxity of the extreme vessels." Dr. Tilt found quinia a very effectual remedy for *irregular menstruation*, accompanied with nervous symptoms, pain

[1] Praeger Vierteljahrs., lxix. 24.
[2] Annuaire de Thérap., 1868, p. 249.
[3] Abeille Méd., xii. 152.

and exhaustion, and more or less leucorrhœa during the intermenstrual periods.[1] Under corresponding circumstances it should be used in the treatment of *amenorrhœa*, but associated with iron and aloetic laxatives.

Administration. *Bark and Quinia administered by the Rectum.*—The administration of bark by enema, especially to children and other persons who cannot readily take it by the mouth, is an old practice, employed by Baglivi, recommended by Helvetius and Home, and mentioned by Cullen. In more recent times, sulphate of quinia has been administered in the same manner. Bretonneau states that a mixture of 120 grains of powdered bark with twenty grains of quinia is more apt to be retained than a solution of thirty grains of the salt alone.[2] In cases of children at the breast, Herpin has used successfully small injections each containing two grains of the salt, and a small quantity of laudanum when there was diarrhœa.[3] Trousseau recommends a rather smaller dose than is usually given by the mouth, and M. Kuhn, of Niederbronn, maintains that half of the latter dose is sufficient, and recommends that, in order to facilitate absorption, the salt should be much diluted. He thinks this plan peculiarly suitable in cases of obstinate intermittent neuralgia.[4] A committee of the Medico-Chirurgical Society of London found that there was no marked or uniform difference between the absorption of quinia from the rectum, and from the subcutaneous connective tissue; and Dr. Stephen Rodgers is convinced by his "own oft-repeated observations that the dose of quinia, in solution, is never more, and as a rule very decidedly less, by the rectum than by the mouth."[5] M. Briquet, who admits the very rapid absorption of the salt from the large intestine, contends, however, that it exerts but a slight medicinal influence. Its physiological effects may be less marked when it is administered in this manner; but the proofs of its curative operation rest upon independent grounds.

Endermic and Hypodermic Application.—Home states that in his time curative effects were sometimes obtained from baths made with a decoction of bark, or by wearing a vest in which coarsely bruised or powdered bark was quilted.[6] In 1759, Pye reported twelve cases of ague cured by the latter means.[7] Cataplasms made of powdered bark and wine, and applied to the abdomen for twelve or eighteen hours, are stated by Trousseau to be sometimes employed. But the most numerous proofs that the virtues of bark are manifested through its external application are furnished by Chrestien,[8] who has published in detail upwards of forty cases of periodical and bilious fevers, etc., in which he employed successfully the tincture and the resinous extract of bark applied with friction to the skin.

But the application of quinia to the denuded cutis generally supplanted these methods. An account of its successful use was first

[1] Lancet (Am. ed.), vol. i. 1851, p 307.
[2] Journ. de Méd., iii. 68.
[3] Bull de Thérap., xlix. 330.
[4] Bull. de l'Acad., xviii. 857.
[5] Med. Record, v. 262.
[6] Clinical Exper., p. 12.
[7] Med. Obs. and Inq., ii. 245.
[8] Méthode Iatroleptice, Montpell. an. xii.

published by Lesieur in 1826.[1] In the following year, Martin, of Narbonne, also used it with advantage, incorporating the quinia with simple ointment in order to diminish the irritant effects of the medicine,[2] and Avenel was equally successful with the powdered sulphate applied to the denuded cutis of the arm.[3] In 1826, Pointe claimed to have effected cures by this method, and also by rubbing the salt into the mucous membrane of the mouth.[4] In 1828, Speranza cured fifteen cases of tertian intermittent by applying eight or ten grains of sulphate of quinia in an ointment to a blistered surface upon the arm. In most of the cases, a single application sufficed.[5] In 1830, Dr. Gerhard's interesting experiments confirmed the previous results. This physician treated upwards of twenty cases of intermittent fever by the endermic method. Nine were of the tertian and the remainder of the quotidian type. In twelve cases, no chill occurred after the first application; in all of the others the disease was cured after one paroxysm, with a single exception, in which it was arrested after the third.[6] In 1833, Dr. Christian, an Irish practitioner, employed the method successfully without being aware that it had previously been used.[7] About the same time the endermic mode of administering quinia was successfully adopted in Germany by several practitioners, especially by Berndt and Lieber.[8] In 1839, M. Dassit cured four cases of intermittent fever in children by means of frictions with an ointment of sulphate of quinia applied to the axillæ.[9] M. Briquet is disposed to regard the application of cinchonic preparations to the sound skin as a precarious and feeble resource, and the use of quinia upon the denuded derm as too painful to be tolerated; but it should be borne in mind that these methods are proposed as substitutes for the ordinary plan only when the latter and the administration by enema are impracticable. In such cases, and with the precaution of diluting the salt with starch or with an ointment before applying it directly to the derm, the plan presents no objectionable feature.

Dr. Chasseaud, of Smyrna,[10] and Dr. Moore, Bombay Medical Service,[11] found the subcutaneous injection of quinia perfectly efficient in the cure of periodical fevers. More recently the method has been generally adopted under certain circumstances by nearly all physicians who are obliged to treat malarial diseases. Undoubtedly, among its advantages the most conspicuous is the rapidity with which it permits the specific action of the medicine to be developed; for in this manner it becomes available for preventing the development or moderating the intensity of a paroxysm of pernicious fever about to take place, when its salutary operation by

[1] Archives Gén., xi. 300.
[2] Revue Méd., xxvii. 569.
[3] Ibid., xxxviii. 21.
[4] Archives Gén., Sept. 1826.
[5] N. Amer. Med. and Surg. Journ., viii. 199.
[6] Ibid., ix. 397.
[7] Lancet, Feb. 1833, p. 689.
[8] A. L. Richter, Die Endermische Methode, 1835, p. 103.
[9] Bull. de Thérap., xvi. 273.
[10] Times and Gaz., Aug. and Oct. 1862, p. 120 and p. 367.
[11] Lancet, Aug. 1863, p. 126.

other channels could not have been so soon secured. Indeed, the rapidity of its action is such that, even when employed after the setting in of the cold stage, it sometimes moderates the severity or prevents the full development of the symptoms. In the comatose forms of periodical fever, when, during the paroxysms, the patient is unable to swallow, this method becomes a precious resource. It is also available in those gastric forms of fever in which the stomach will tolerate neither food nor medicine, or when it is considered necessary to employ emetics as well as quinia. Infants and children who resist all attempts to administer a bitter potion by the mouth, can readily be controlled while a subcutaneous injection is made; and among soldiers, sailors, etc., who are adroit in deception, this method allows no opportunity of avoiding the treatment prescribed for them. Finally, it insures a very considerable economy of a costly medicine.

On the other hand, an acidulated solution of sulphate of quinia introduced through the skin into the connective tissue, occasions a wound in the former and maintains an irritant in contact with the latter. The first effect is a burning and smarting pain in the part, followed by redness and swelling, all of which symptoms may be dissipated in the course of three or four days. But sometimes a gangrenous eschar forms around the puncture; sometimes the original swelling and redness increase, the part grows hard and painful, and is cured by gradual resolution or is transformed into an abscess, which may be quite superficial or involve the subcutaneous tissue, and require a free incision to discharge its contents. We saw in consultation a case in which the hypodermic injection of quinia into the calf of the leg resulted in the formation of a large dissecting abscess which tended greatly to aggravate the patient's already critical situation. M. Arnould, who has carefully studied the effects of this method, estimates the proportion of cases in which an abscess occurs, at one-tenth,[1] which we cannot but believe to be greater than is met with in civil practice, and in cooler countries than Algeria, where his observations were made. A still greater drawback to the advantages of this method exists in the possible peril to which it exposes the patient's life. Several cases in Europe and in the United States are reported of death from the subcutaneous injection of sulphate of quinia.[2] In one that took place at New Orleans fatal tetanus is said to have resulted from the operation. It is very true that these results are quite exceptional, and may not occur in more than one or two per cent. of the whole number of hypodermic injections of quinia. But if they occurred in only one case out of a million, that fact would constitute no argument in favor of an unnecessary operation.

These considerations should restrict the method to those cases chiefly in which the use of the medicine is urgent, or the difficulties of administering it by the mouth and rectum are insuperable, or at least not to be overcome without greater risk than attends the

[1] Bull. de Thérap., lxxii. 110. [2] Medical Record, ii. 252.

operation. In many grave cases it may be employed at first to ward off a pressing danger or avoid an insurmountable obstacle, but the subsequent treatment should be conducted in the ordinary manner.

In regard to the dose of quinia to be injected, it must of course vary as much as that which is given by the mouth. Its proportion to the latter is estimated in nearly the same manner by different physicians. Mr. Moore, for example, states it at a fifth or a sixth, or from four to eight grains, while Arnould gives the proportion as between one-third and a half, or between four and six grains in mild, and between seven and nine grains in severe cases.

The method of performing the operation has been described elsewhere, but it may now be added that if the liquid is warmed the solution of the salt is rendered more complete, and the pain of the injection is moderated. It is of importance that the salt be perfectly dissolved, not only because it will otherwise occasion more pain and local irritation, but also because it may clog the injecting tube and defeat the purpose of the operation. One part of sulphate of quinia is soluble in ten parts of water acidulated with sulphuric acid, and this is the solution generally employed; but different physicians have proposed the addition of tartraric or nitric, instead of sulphuric acid. But the first of these is alleged to be inefficient, and of the second we have but little information. According to Lorent, thirty grains of acetate of quinia will dissolve by the aid of heat in two and a half drachms of water. The acetate is prepared by saturating a solution of the acid with quinia and evaporating. Ether and also glycerin have been proposed as solvents; but the former is extremely irritating and apt to occasion abscess, and the latter merely suspends but does not dissolve the salt.

Powdered Bark.—The yellow Calisaya, or the new Carthagena bark, is to be preferred for internal administration. As a tonic, it may be given in doses of from *thirty to sixty grains* daily; as an antiperiodic, the quantity necessary to prevent the return of a paroxysm varies from *sixty grains to an ounce*, according to whether the attack is simple or pernicious, or whether the patient is treated in or at a distance from a miasmatic locality. Bark may be given in substance mixed extemporaneously with water, or made into a bolus with syrup or honey; but in this manner it is very nauseous, as well as disgusting in appearance. It is more readily tolerated when the vehicle employed is a light French or German wine, and when the mixture has been made some time before. A sweetened infusion of coffee masks the bitterness of the medicine, as it does, to some extent, that of quinia. Elliotson, and also Neligan, have recommended milk as a very excellent vehicle. It is, however, always objectionable to employ an article of food as the excipient of a disagreeable medicine.

Decoctions and Infusions.—These preparations are used only as tonics, and in the dose of *two fluidounces* three or four times a day.

Tinctures.—The simple tincture may be given in doses of from *one to four fluidrachms*, and the compound tincture in doses of *a*

fluidrachm, whenever a stimulant as well as a tonic effect is desired. Their principal use is in typhoid states of disease, and to counteract the debility which precedes convalescence after various exhausting maladies.

Extracts.—The extract of cinchona is recommended to be given in doses of from *ten to thirty grains.* It is exclusively employed as a tonic, and frequently with great advantage when the preparation is genuine.

The *fluid extract* is of more uniform strength, and is a very efficient tonic in the dose of about twenty minims, which is equivalent to *sixty* grains of bark.

Sulphate of Quinia.—The dose of this salt as a tonic is *one grain*, repeated three or four times a day. As an *antiperiodic* in simple intermittent or mild remittent fever, *six or eight grains* are sufficient to avert the paroxysm; in severer cases of these affections the dose must be raised to *fifteen or twenty grains*, and in those of a malignant type to *thirty*, *forty*, or even *sixty* grains, given in both of the latter cases in divided doses. Intermittent neuralgic diseases require doses sufficient to produce the physiological effects of the medicine in a marked degree.

The intense bitterness of quinia has led to the invention of various methods for its administration. These are probably of secondary importance relatively to its therapeutical effects, for, as Mialhe has observed, it is quinia, and not its sulphate or any other salt which operates upon the system. In whatever way the base is combined it undergoes decomposition in the blood by means of the alkaline carbonates contained in that liquid.[1]

Sulphate of quinia may be administered in powder, enveloped in a wafer made with flour and the white of egg, in thick mucilage or jelly, or in pills coated with gelatin, or covered with silver or gold leaf. But all of these methods are objectionable, because they bring the pure salt in contact with the mucous membrane of the stomach, and lead to its irritation. Quevenne, and also Bertella, have shown that a syrup acidulated with citric or tartaric acid serves partially to disguise the bitterness of the medicine. Various bitter and astringent liquids fulfil this purpose still more completely, such as tannic acid, coffee, and tea, but the mixture produces a precipitate of the insoluble tannate of quinia, which is probably decomposed but slowly in the stomach. M. Bouvier insists that the antiperiodic virtues of the tannate of quinia are equal to those of the sulphate, while it is less irritating to the stomach, and affects the nervous system less.[2] Chocolate may be used to remove the bitter taste from the mouth after quinia in solution has been taken, but a still better mode of neutralizing the bitterness of the medicine is to associate it with a fluid extract of liquorice. By far the best form in which sulphate of quinia can be given, when the dose is to be small, is that of solution in water acidulated with aromatic sulphuric acid, in such manner that each tablespoonful of the

[1] Chimie Appliquée, p. 510. [2] Bullet. de l'Acad., Fev. 1852.

liquid shall contain one grain of the salt and one drop of the acid. One or two drops of laudanum should generally be added to each dose in mild forms of intermittent, and from five to ten or more drops in the grave forms. Dr. C. Binz[1] has shown by numerous and careful experiments that unless the sulphuric acid in the solution be considerably in excess, the latter will become decomposed, with the destruction of more or less of the quinia and the formation of fungoid growths. He observed that solutions of the muriate of quinia are less liable to undergo such a change, and as this salt is soluble in 60 but the sulphate only in 800 parts of water, he regards the former as preferable for ordinary use. We have been much in the habit of prescribing this salt dissolved in tincture of chloride of iron.

Quinoidia, Crude or Amorphous Quinia.—This preparation may be given in the same doses as the sulphate of quinia. It is insoluble in water, and its slight bitterness renders it appropriate for administration to children and others who object to the taste of the sulphate. It may be given in some mucilaginous liquid, in syrup, honey, or preserves. As it must dissolve slowly in the stomach, a longer time is necessary for it than for quinia to develop its effects.

Sulphate of Quinidia may be prescribed in the same manner as sulphate of quinia, and *sulphate of cinchonia* in doses one-third larger.

Besides those which have been mentioned, and which alone are generally used, several other preparations have been proposed. The following are the most important of these: the *muriate*, which is not a permanent salt; the *arseniate*, and the *arsenite*, whose irritant properties render them objectionable; the *sulpho-tartrate*, which M. Bartella[2] conceives to be more active than the sulphate, but which M. Briquet has shown to be feebler physiologically as well as therapeutically; the *tannate*, which, according to the same authority, is six or eight times less active than the sulphate; and the *ferrocyanate*, which Dr. Wooten, of Alabama, found more powerful than the sulphate as a nervous sedative,[3] but which the experiments of M. Briquet prove to be imperfectly absorbed, and feeble in its action even when twenty or thirty grains a day were given in divided doses.

SALIX.—Willow.

Description. *The bark of Salix alba.*—The bark of other species of willow may be used with equal advantage. The genus Salix comprises a great number of species which are natives of North America and Europe. The officinal variety comes from the latter country, but is cultivated in the United States, along the borders of small streams, and its young and pliant branches are employed

[1] Virchow's Archiv, xlvi. 79; Exp. Untersuch., etc., Berlin, 1868.
[2] Bull. de Thérap., xiv. 534.
[3] Am. Journ. of the Med. Sci., Jan. 1847, p. 252.

for making baskets, and its wood in the manufacture of gunpowder. When allowed to grow it becomes a tall tree, with numerous branches, the younger of which have a delicate greenish color. The leaves, which are shining and white on the under surface, are lance-shaped, alternate, and have acutely serrated edges.

The bark obtained from the smaller branches, two or three years old, is found rolled in quills, of a slightly aromatic odor, and a bitter and astringent taste. Its virtues, which it yields to water and to alcohol, appear to depend upon a peculiar proximate principle, *salicin*, and upon *tannic acid*. Salicin is a white, transparent, crystallizable, neutral substance, of a silky lustre, without odor, and very bitter. It is soluble in water, and more readily in alcohol.

History.—Willow bark was anciently employed in medicine, but almost exclusively as an astringent. It seems, as well as the leaves, to have been a popular domestic febrifuge before it was introduced into medicine. Mérat and De Lens, who carefully investigated its medical history, state that in Austria, in 1694, Ettner used an infusion of the leaves as a febrifuge.[1] It was first recommended in the treatment of intermittent fever by Stone, of London, in 1763, who reported the cure of fifty patients by its use.[2] In 1772, Gunzius proposed it as a substitute for cinchona, and from that time to 1825, when Fontana announced salicin as the active principle of the bark, it was successfully employed as an antiperiodic remedy by Koenig, Coste, Willemet, Vauters, Burtin, and others.

Action and Uses.—Like the simple bitters, willow bark appears to augment the appetite and improve the digestion, and if its use is long continued, it confines the bowels. It also manifests a decidedly antiperiodic power in intermittent fevers.

Given in the form of infusion, or of powder, which is said to agree better with the stomach than powdered cinchona, willow bark is useful in many cases of *feeble digestion*, and of *general debility* induced by excessive discharges of pus or other liquids. It has been thought to be particularly useful in chronic mucous discharges from the urinary passages, and also from the lungs. It has also had some repute as a *vermifuge*. Powdered willow bark, like powdered cinchona, is sometimes used as a dressing for *gangrenous* or otherwise fetid or unhealthy *ulcers*.

Salicin is said to possess the tonic power in a very slight degree, but it often manifests decided antiperiodic virtues. On its first discovery, and subsequently, the reality of this property was attested by Girardin, Miquel, Andral, Lobstein, Barbier, Blom, Pleischl, and other physicians. According to Barbier, and also to Pleischl, it is a very efficacious remedy, and sometimes cures cases of *intermittent fever* which have resisted quinia.[3] Blom employed it chiefly when quinia was contra-indicated by vascular congestion of the head, and violent headache.[4] Dr. Fenner, of New Orleans, tried

[1] Dict. de Mat. Méd., vi. 179.
[2] Murray, App. Med., i. 67.
[3] Mat. Méd., i. 395.
[4] Edinb. Med. and Surg. Journ., Oct. 1837.

this medicine in twenty cases of intermittent fever, giving it in doses varying from five to sixty grains, the average amount taken by each patient being one hundred and eighty-eight grains. It was successful in eleven cases only. Its general effects seemed to be tonic and diaphoretic.[1]

Now that it is well known that at least one-half the number of cases of recent intermittent fever may be cured without a specific remedy, and merely by transferring the patient to a salubrious atmosphere, and surrounding him with otherwise favorable hygienic conditions, the peculiar virtues attributed to willow bark and its proximate principle are more than ever questionable. They are seldom appealed to by physicians, yet they may occasionally be invoked in the absence of quinia, or when this medicine is objected to, or disagrees with the patient.

Administration.—Powdered willow bark may be given in doses of from twenty to sixty grains three times a day, as a tonic; as an antiperiodic, the dose must be repeated, so that at least an ounce shall be taken during the intermission. A *decoction* or *infusion* may be made with an ounce of the bark to a pint of water. The dose of salicin, as an antiperiodic, is stated at five grains, and it should be repeated during the apyrexia, until thirty or forty grains are taken.

CORNUS FLORIDA.—Dogwood.

Description.—Dogwood, which is a native of this country, is a small tree which abounds in rich and shady lands, and is conspicuous for the white involucre of its flowers in the spring, and by its brilliant, shining, red berries, and its many-colored leaves in the autumn. The wood is hard and compact, and the younger branches are fibrous when broken. The officinal portion of dogwood is the bark, especially that of the root. It is of reddish-gray color, has a very slight odor, and a bitter, astringent, and a slightly aromatic taste. It yields its virtues to water and to alcohol. The root bark yields *cornic acid* in the form of stellate silky scales of bitter taste. It is soluble in water and alcohol.

Medical Properties.—This substance is tonic, astringent, and slightly stimulant, and in the recent state is apt to excite nausea. Various practitioners have testified, with probably more zeal than knowledge, that it is equal to cinchona in the treatment of *intermittent fever*. Where the latter remedy cannot be procured dogwood bark may be tried, and will, doubtless, like other vegetable bitters, occasionally succeed. As a simple tonic its efficacy is unquestionable. The ripe fruit infused in brandy is a popular stomachic.

The dose of the bark in powder is twenty grains as a simple tonic, and sixty grains repeated six or seven times during the apyrexia, as an antiperiodic. The *decoction*, which is officinal, is made

[1] N. Orleans Med. and Surg. Journ., ii. 415.

by boiling a troyounce of the bruised bark in a pint of water for fifteen minutes, and adding sufficient water through the strainer to make the decoction measure a pint. It may be given in doses of two fluidounces.

C. sericea, or *swamp dogwood*, possesses the same general qualities as the above species, but is less bitter and more astringent; *C. circinata*, or *round-leaved dogwood*, which is most common in New England, is very bitter, and is much employed in that region as a tonic and stomachic.

HYDRASTIS.—HYDRASTIS.

Hydrastis is the root of *Hydrastis Canadensis*, a small, herbaceous, and perennial plant, which abounds in low moist places in the northern, and in mountainous localities in the southern portions of the United States, and which is popularly known as Yellow-root, Orange-root, Golden Seal, and Yellow Puccoon. It is readily recognized by its roundish-cordate, lobed, and pubescent leaves, of which there are usually only two mounted on a short slender stem. It bears a rose-colored or purplish flower, which is followed by a berry of similar color, resembling the raspberry in form. The stem arises from a thick, fleshy rhizome, from which numerous slender radicles proceed. When fresh the exterior as well as the interior of the root is yellow, but, on its being dried, the former becomes dark brown, rough, and contorted. It is usually several inches in length, and two or three lines in thickness. Its odor is characteristic, somewhat rank and narcotic, and its taste is bitter and peculiar. It yields its virtues to alcohol and water. They are supposed to depend upon two alkaloids, *hydrastia*, and another which is said to be identical with *berberina*. The odor of hydrastis is ascribed to the presence of a volatile oil. The only officinal preparation of hydrastis is the *fluid extract* (EXTRACTUM HYDRASTIS FLUIDUM).

Action and Uses.—This root was one of the medicinal plants of the American aborigines, and was also used by them to prepare a yellow dye. Its bitter taste doubtless led to its employment as a tonic in states of general debility and *impaired digestion*, and of its efficacy under such conditions no reasonable doubt can be entertained. Nor is it less likely that it possesses a certain degree of efficacy in *periodical fevers*, as much, at least, as the rest of the simple bitters. The allegation that hydrastia occasions nervous phenomena resembling those produced by full doses of quinia, although frequently made, does not rest upon any such concurrent testimony as the importance of the statement demands. The further statement that it is also aperient and cholagogue, diuretic and alterative, with a special operation upon the mucous membranes not only of the intestine but of the genital organs of the male and female, and upon the urinary apparatus, could only have originated with persons ignorant alike of the laws which govern the actions of

medicines, and of the nature of disease. If we add to the heterogeneous conditions which are claimed to illustrate its virtues as an internal medicine, that its decoction is said to be efficacious as a topical application in ophthalmia, ulcers, etc., we shall probably be persuaded that it must either deserve a place in the materia medica which no other medicine possesses, or that the qualities ascribed to it are for the most part illusory.

Administration.—A decoction is made by boiling an ounce of the bruised rhizomes in a pint of water for ten or fifteen minutes: of this one or two ounces may be given two or three times a day. Of the fluid extract a teaspoonful may be administered as frequently.

NECTANDRA.—NECTANDRA.

Description.—Nectandra, or Bebeeru bark, is the bark of Nectandra Rodiei, or Greenheart tree, a native of Guiana and the adjacent country. It is a tall tree with a smooth, grayish bark, which in commerce is found in flat heavy pieces of a reddish-brown color within. Its taste is strongly bitter and astringent, with some pungency. Its bitterness is in a great measure due to *bebeeria*, or *nectandria*, an alkaloid which in its constitution and also in its action is closely analogous to quinia. It is obtained from the bark by the same process which is used to extract quinia from cinchona bark. It is of a pale yellowish color, amorphous, and of a resinous aspect, very bitter, is soluble in alcohol and ether, but slightly so in water, and has an alkaline reaction. Its sulphate is in thin brownish scales, which become yellow in powder. It is very soluble in alcohol, but imperfectly so in water unless acidulated. Nectandra contains another alkaloidal principle, *sipeeria*, which, unlike bebeeria, is insoluble in ether. These bases are combined in the bark with *bebeeric* acid.

History.—Attention was first attracted to this bark as a substitute for cinchona in 1834, by Mr. Rodie, an English naval surgeon in Demarara. Its bitter taste led him to examine it chemically with the results above stated, and to employ it medicinally with success. In 1843 Dr. Douglas Maclagan, of Edinburgh, confirmed Mr. Rodie's observations and conclusions.[1] Similar results were obtained by several British physicians, and after the lapse of some years by Becquerel, in Paris,[2] and in this country by Patterson,[3] Dailey,[4] and Pepper.[5] It seemed to have passed out of notice, when attention was called to it anew by Macchiavelli, in 1871, who, however, added nothing to the existing knowledge of the subject.[6]

Action.—The earliest reporters of the application of bebeeria to the cure of periodical fevers claim for it an almost total freedom from the objectionable qualities of quinia, such as the production

[1] Lond. and Edinb. Monthly Journ., v. 651.
[2] Bull. de Thérap., xli. 295.
[3] Philad. Med. Exam., 1852, p. 277.
[4] Ibid., 1853, p. 557.
[5] Am. Journ. of Med. Sci., Jan 1853, p. 13.
[6] Practitioner, vii. 307.

of headache, ringing in the ears, deafness, irritation of the stomach, etc. Its functional operation, when administered in small doses, seems to be indentical with that of quinia in similar quantities, improving the appetite and strengthening the digestion. There is no record of any peculiar results from large doses. It is worthy of notice that in the frog bebeeria and quinia, when employed hypodermically, occasion almost identical symptoms. Albers introduced half a grain of powdered bebeeria beneath the skin of a frog's thigh; in about forty minutes the head was drawn forcibly upwards and backwards, and the arms were stretched stiffly along the flanks.[1] Hoppe placed half a grain of quinia beneath the skin of a frog's back. At the end of three-quarters of an hour, the animal's body was bent tetanically backwards.[2] It is equally noticeable that when given to the same animals internally, neither of these agents occasioned tetanic symptoms. Albers also calls attention to the fact that the rigidity produced in frogs by bebeeria is identical with that occasioned by theine and caffeine in the same animals, and in contrast with that produced by strychnia; for in the latter only is the reflex function abnormally developed, spasm being produced by all physical excitants of the superficial nerves.

Uses.—The most important use of bebeeria is in the treatment of *miasmatic periodical fevers.* The physician who introduced it, Dr. Rodie, found it in a great many cases of remittent equally efficacious with sulphate of quinia, and that it cured the fever when quinia had failed. Drs. Watt and Blair, who also practised in the West Indies, gave a similar estimate of its virtues.[3] Dr. Maclay, in 1845, refers to about forty cases of periodical fevers treated by it in various climates, and states it to have failed in only about one-seventh of the number.[4] Dr. Patterson, of this city, was induced, by his limited experience, to attribute to it an efficacy not inferior to that of quinia; Dr. Daily found its effects less satisfactory than those of quinia; and Dr. Pepper reported its success and its failure in equal numbers of cases. In Paris, the trials of the medicine by Becquerel led to a nearly similar result.[5] Whence it may very well be concluded that so long as the preparations of cinchona can be obtained, it will be unnecessary to resort to nectandra for the cure of periodical fevers.

In his original papers on this subject, Dr. Maclagan reports the results of his using bebeeria in the treatment of *periodical headaches*, which appeared to him, on the whole, favorable. Christison[6] went so far as to assert that "periodic headache and other periodic neuralgias readily yield to it," and stated that it had been found useful in the latter stages of phthisis to counteract general debility and want of appetite, and check nocturnal perspiration; also in strumous ophthalmia, atonic dyspepsia, states of debility, and in cases of pregnancy requiring tonic treatment. As long ago as 1855 Dr.

[1] Virchow's Archiv, xxiv. 307.
[2] Die Nervenwirkung der Heilmittel., 1856.
[3] Lond. and Edinb. Journ. of Med. Sci., iii. 685.
[4] Ibid., v. 415.
[5] Bull. de Thérap., xli. 295.
[6] Dispensatory.

A. P. Merrill claimed for this medicine a singular efficacy in *menorrhagia*, and a certain power in *leucorrhœa* and in pruritus vulvæ,[1] and in 1868 he added to this list "all disorders dependent in whole or in part upon hypertrophy and hyperæmia of the uterus and its appendages."[2] These affections and conditions are among those in which quinia is well known to be beneficial, and we can, therefore, accept the suggestion of using bebeeria in their treatment, when quinia cannot be procured.

The *dose* of sulphate of bebeeria is from two to five grains. It should be given like sulphate of quinia in an acidulated solution.

ÆSCULUS HIPPOCASTANUM. *Horse Chestnut.*—This well-known tree is a native of Asia, and was transplanted to Europe in the 16th century. The bitterness and astringency of its bark, no doubt, first caused it to be employed as a medicine. It was first applied to the treatment of intermittent fevers in 1720, and a large number of witnesses published their testimony in its favor during the 18th century. During the wars of the French republic and empire it was again brought into notice in consequence of the difficulty of importing cinchona, produced by the continental embargo; but its virtues were not very highly estimated.[3] Canzonieri obtained from the capsules of the fruit an alkaloid, which he denominated *esculin*. It is slightly bitter, almost insoluble in cold water, soluble in 12 parts of boiling water, and still more soluble in alcohol. In evaporating the mother liquor it is deposited in fine acicular crystals.

Several physicians of Lyons employed it successfully in the cure of *intermittent fever*. Of twenty-eight cases of this affection, eighteen were cured, the remainder only yielded to quinia. Four cases of periodical *neuralgia* were cured promptly by the same medicine, and in one of them sulphate of quinia had previously been prescribed ineffectually.[4] Seven other cases of equal success were reported by M. Monvenou.[5] The *dose* of esculine is stated to be *fifteen grains*, which, in the cases just referred to, was given twice a day, with a short interval between them.

These facts leave no doubt of the antiperiodic virtues of æsculus and of esculine; but, like so many other medicines, they are not likely to be in great request while we possess more powerful and certain remedies in cinchona and its alkaloids.

PRUNUS VIRGINIANA.—WILD CHERRY.

Description.—The bark of *Cerasus serotina.*

The wild cherry is a large tree which abounds in most parts of the United States, but attains its greatest height in the Southern States. The leaves are smooth on both sides, pointed and serrated

[1] N. Y. Journ. of Med., Nov. 1855, p. 433.
[2] The Med. Record, ii. 7.
[3] DIEU, Mat. Méd., iv. 556.
[4] Bull. de Thérap., lv. 559.
[5] Ibid., lvii. 127.

on the edges. The flowers, which are white, have a smell of bitter almonds, and the fruit, which is in pendulous racemes, consists of round blackish berries, which have a pleasant, but somewhat astringent taste. They are eagerly devoured by birds.

The bark of the roots and branches is employed in medicine, but the former is preferred. It is found in the shops deprived of its epidermis, of a reddish-brown color. It is readily pulverized. It is bitter and aromatic in taste, and when fresh has the smell of bitter almonds. According to the analysis of Mr. Procter, it contains resin, amygdalin, starch, tannin, gallic acid, etc., and on distillation with water, it yields a volatile oil combined with hydrocyanic acid. These products are ascribed to a fermentation produced between the water and the amygdalin of the bark under the influence of an albuminous principle, emulsin, which has the property of converting amygdalin into volatile oil of bitter almonds. If an infusion be made with hot water, this conversion does not take place, for the agent producing it, emulsin, is coagulated.

Action.—It will be perceived, from the preceding account, that wild-cherry bark possesses a very anomalous constitution, containing, as it does, a tonic, and also a directly sedative ingredient. Their influences, however, which at first sight appear incompatible, are in reality not so; for there are many morbid conditions in which excitability of the nervous system, and sometimes even of the heart, is associated with debility of the organic functions, and particularly of digestion. Indeed, we have in this medicine a combination not unlike those which are so frequently employed in chlorosis, and which are adapted to control nervous irritability on the one hand, and to impart tone to the system on the other. If it were more powerful, the field of its usefulness would be greatly enlarged.

From the experiments of Dr. Morris, in 1802, it was inferred that the action of wild-cherry bark, in doses of thirty grains, is primarily to *quicken* the pulse, but ultimately to render it fuller and stronger.[1] Dr. Eberle also says, that, "when taken into the system, it produces a slight increase of the action of the heart and arteries, and induces, in some individuals, considerable drowsiness." He adds, however, "when it is taken in *large* quantities, and frequently repeated, it weakens the digestive organs, and produces an effect upon the action of the heart and arteries the very reverse of a stimulant. In my own person I have several times reduced my pulse from seventy-five to fifty strokes in a minute, by copious draughts of the cold infusion, taken several times a day, and continued for twelve or fourteen days."[2] Dr. F. P. Porcher states that having employed several ounces of the infusion three times a day in a case of hypertrophy of the heart, the force of the patient's circulation was at first diminished; but the abatement was not progressive.[3] These effects, even in what they appear to be discordant, resemble those produced by medicinal doses of prussic acid. It is also to be observed, that

[1] Dr. Carson, in Pereira's Mat. Med., 3d Am. ed., ii. 777.
[2] Mat. Med. and Therap., 6th ed., p. 231.
[3] Trans. Am. Med. Assoc., ii. 737.

in Morris's experiments the powder was used, and in those of Eberle and Porcher, the cold infusion; so that in the former case it is probable that but little prussic acid was generated, and that the tonic action of the medicine predominated. The large doses of the infusion taken by Eberle, before a sedative effect was produced, show that very little of this action is to be looked for from the ordinary doses of the preparation.

Uses.—Wild-cherry bark is more employed in the treatment of *pulmonary consumption* than in any other affection. It is supposed to improve the appetite and strengthen the digestion, while it palliates the cough and allays the irritability of the nervous system, when this arises under the exhausting progress of the disease. As a gentle and harmless palliative, it is certainly to be recommended, but no evidence that can be called rational exists to show that it in the least degree postpones the inevitable issue. In so-called nervous coughs, or those in which the act of coughing is excited by disease elsewhere than in the lungs, or when the cough in slight bronchial or laryngeal irritation is violent in proportion to the local cause, this medicine is often of singular efficacy. In some cases of the kind the syrup forms an eligible preparation.

It is of much more evident utility in the *convalescence from acute diseases* accompanied with exhausting discharges, when the nervous susceptibility is manifested by a still lingering daily exacerbation of fever. Although inferior to cinchona in this respect, it is more agreeable to the patient, and often of sufficient power to enable the system to pass with ease and speed through convalescence. When once the febrile erethism has been subdued, and the appetite and digestive powers begin to improve, the simple bitters are greatly to be preferred.

From a knowledge that this bark contains prussic acid, it has been used to allay *excessive action of the heart* in organic as well as functional affections of this organ, and there are many who confide in its efficacy. The experiment of Eberle upon himself, and the case related by Dr. Porcher, prove that, except in enormous doses, it is inefficacious in reducing the heart's action, at least for any length of time. Doubtless, when the palpitations depend upon anæmia, it may form a useful adjuvant to iron, calming excitability, while exerting some tonic influence; but its value here is altogether secondary. If irregular action of the heart depends upon organic defects alone, it is possible that the bark may sometimes moderate its tumult and thus assuage the suffering which arises from that cause. In England, where the use of this medicine has but recently become known, its sedative operation upon the heart appears to have been recognized by Dr. Allbutt, who attributes to it a very decided and useful influence in cases of palpitation of the heart associated with mitral regurgitation.[1] If the disorder be due to dyspepsia, especially flatulent dyspepsia, as it is much oftener than is generally recognized, this medicine will be

[1] Times and Gaz., Feb. 1867, p. 161 and p. 217.

found an appropriate, but not a very efficient, remedy. Although we have used it a good deal, we have never witnessed important effects from it beyond that of gratifying the patient with a pleasant and slightly tonic beverage. The fluid extract is by far the most active preparation of wild-cherry, and is to be preferred to the powder and the infusion.

Administration.—Wild-cherry bark may be given in the form of powder, infusion, or syrup. The first is never used, but the dose of it is usually stated at thirty or forty grains several times a day.

The *infusion* (INFUSUM PRUNI VIRGINIANÆ), which is officinal, is directed to be made by displacement, with (cold) water in the proportion of half a troyounce of the coarsely-powdered bark to a pint of water. The dose is two or three fluidounces.

The fluid extract is prepared by exhausting the bark by means of alcohol and water. The dose is a teaspoonful.

The *syrup*, which is a very agreeable preparation, may be used as a vehicle for sedative or narcotic medicines, or as a sweetener for cough mixtures in cases unaccompanied by acute fever.

SIMPLE BITTER TONICS.

MEDICINES belonging to the group of tonics generally denominated simple bitters contain a bitter principle, which is crystallizable in some cases, but not in others, and upon which, in each instance, their virtues are supposed to depend. Although exceedingly simple in their operation, exerting, as they do, no influence beyond augmenting the appetite and invigorating the digestive organs, it is easy to perceive that their applications in practice must be very numerous. There are few cases of acute disease in which the decided improvement of the patient does not date from an awakening of the appetite for food; and whenever this instinct is not spontaneously developed—whenever the patient continues languishing and suffering beyond the ordinary period of convalescence, although no apparent cause should account for the delay—an indication exists for the administration of bitter tonics. Even when the appetite revives, if it does not manifest a due degree of vigor—if the food appears to lack its proper flavor, or if it oppresses the stomach and disturbs the bowels, although of the proper quality and used without excess—a few doses of gentian, columbo, or quassia will frequently restore its natural zest to the appetite, secure a good digestion, and promote the health "that waits on both." Such cases present the most signal instances of the utility of these medicines, which often appear to form the necessary means of passage from sickness to health.

But in more chronic cases of gastric debility they are also of

essential service. In almost all diseases of long duration, in which the patient is exhausted by discharges of blood, pus, or other liquids, or endures severe pain, or, finally, is habitually deprived of his needful rest, the digestive function sooner or later becomes impaired. If, before its powers have sunk too low, these medicines are administered, they enable the stomach to compensate, by its supply of nutritive materials, for the waste of tissue which the disease occasions, and thus sustain the system until the primal cause of its exhaustion is removed. There is a form of gastric debility which is exceedingly common in this country, as well among persons who are exhausted by bodily toil as among those whose minds are perpetually harassed with the calculation of pecuniary gains, or depressed by the passions (too often of the baser sort) which assail those who enter into the political struggles of the day. In many cases, it is true, this condition is induced by an abuse of alcoholic stimuli; but in many, also, its origin is in the incessant, unrelaxing application of mind or body, or both, to the details of business, and the habit of devouring indigestible food without regard to the ability of the stomach to convert it into nutriment. By such influences a disorder of the stomach is induced in which acidity, flatulence, and often pain, are superadded to a simple want of vigor in the digestive function, constituting the most ordinary form of chronic dyspepsia. Still more important symptoms may ultimately be developed, consisting of various disorders of the nervous system, and not unfrequently terminating in hypochondriasis or other form of mental derangement. The primary cause of these manifold evils is oftentimes the disordered function of the stomach. In the forming stage of the complaint the medicines under consideration are frequently adequate to the cure; but when once the lower bowels and the liver have become torpid, and the muddy hue of the skin, the icterode tint of the eye, and the loaded tongue denote an alteration of the circulating fluid itself, a morbid state of the secretions, and a disturbance of the nervous functions, they are insufficient by themselves to give relief. Their use must be preceded by evacuants—by emetics, purgatives, and cholagogues; and by the warm bath, or some other appropriate stimulant to the skin. These various agents reduce the disorder to a simple gastric debility which bitter tonics are especially adapted to cure. A very common ailment among persons who lead a sedentary life, even without an excessively close application to labor, and without any injudicious use of food, is sick headache. When the circumstances or the disinclination of the patient prevent him from employing the most effectual means of cure—a complete renunciation of his sedentary pursuits, and the adoption of vigorous and exciting exercise in the open air—he will find that pure bitter tonics, with such a regulation of his habits as may be possible, will be of more service in palliating his ailment than any other means whatever. Among these medicines quassia and columbo are the most useful in the cases referred to. When the attacks are periodical, the remedies should be used during one-

half only of the interval between them, whether the first or the second half will depend upon the state of exhaustion following the attack, or the character of the gastric derangement which precedes it. In all of these cases other means may be necessary to remove particular symptoms, as purgatives when there is constipation, alkalies when there is acidity of the stomach, and during the attacks stimulants and even narcotics; but a curative effect must be sought in bitter tonics, or in some analogous agency.

Bitter medicines are sometimes spoken of as possessing anthelmintic virtues; but this remark, with strict propriety, applies only to one or two of them which contain an essential oil. Simple bitters in general have no power of the sort except that which they may occasionally exert by increasing the vigor of the digestive organs, or, when taken in large doses, by their purgative effect. It is possible that quassia may, to some extent, be an exception to this statement, since, as mentioned elsewhere, there are numerous examples of its poisonous action upon insects, and even upon quadrupeds.

CALUMBA.—Columbo.

Description.—Columbo is the root of *Jateorrhiza palmata* (Miers), *Cocculus palmatus* (De Candolle). This plant, as found in commerce, consists of transverse slices of the root, of a circular or oval shape, from half an inch to three inches in diameter, and from one to four lines in thickness. Its cortical portion is from one to three lines thick, and is separated by a dark line from the ligneous portion. The latter is of a greenish-yellow color, is arranged in several concentric layers, and is depressed in the centre, which is occupied by the shrunken medulla. It has a faint aromatic odor, and a very bitter and somewhat aromatic taste. The central portion is mucilaginous, and, on account of the starch, which all parts of the root contain, it is readily attacked by insects, and its infusion rapidly undergoes fermentation. The taste, and probably the medicinal qualities of columbo, depend upon two proximate principles, *columbin* and *berberin*, the former of which is slightly soluble in water, alcohol, acetic acid, and alkalies, while the latter is very soluble in alcohol, from which it is precipitated by water. It is easily soluble in boiling water. From these facts, it follows that the active properties of columbo are not wholly extracted by a watery infusion. It contains neither tannic nor gallic acid. An infusion of tincture of galls gives a precipitate with an infusion of columbo, and when tincture of iodine is added to a decoction of the root, the presence of starch is revealed by the blue color which is produced.

Action.—No experiments besides the inconclusive ones of Percival have been made to illustrate the physiological action of this medicine. Our notions of its operation must therefore be drawn from its effects in disease. From these it may be inferred that columbo is a pure stimulant stomachic tonic, increasing the appe-

tite, and improving the digestion. Owing to its containing no tannin, it does not tend to constipate the bowels, and doubtless the starch and gum which are so abundant in it contribute to prevent this effect.

Uses.—Columbo was introduced into medical practice by Dr. Percival, who states that the inhabitants of the East Indies have for a long time used it in disorders of the stomach and bowels.[1] He also cites the testimony of a surgeon who long served in the East Indies to the effect that in *cholera morbus* it alleviates the tormina, checks the purging and vomiting, and speedily recruits the exhausted strength. Of his own knowledge, he states that it is serviceable in moderating the violence of the early symptoms of dysentery, but still more so as a cordial and tonic in the decline of the attack. The same writer speaks of its beneficial effects when given with an equal or double quantity of sulphate of potassa, in the treatment of bilious fevers. But it was as a *stomachic tonic* that Percival especially recommended this medicine. He prescribed it for the *vomiting* and *purging* incident to the period of dentition, for habitual vomiting proceeding from weakness of the stomach, and in that which occurs during pregnancy; also in a languid state of the stomach attended with want of appetite, indigestion, nausea, and flatulence. If there was constipation, he associated it with rhubarb; and if the bile appeared to be defective, with inspissated ox-gall. Subsequent observation appears to have confirmed the opinion entertained of columbo by this eminent physician, and there is, at the present day, no medicine of its class which is more frequently or more successfully employed in repairing the loss of tone which, often accompanied with paroxysmal pain, affects the stomach of persons devoted to sedentary pursuits. In such cases an infusion may be employed with advantage which was recommended by Percival, and is made with an ounce of powdered colombo, half an ounce of orange-peel, two ounces of French brandy, and fourteen ounces of water. The whole should be macerated for twelve hours without heat, and then filtered. If a decided laxative action should be required, the addition of sixty grains of rhubarb, or twice as much senna, may be made to the ingredients of the infusion. Although the use of columbo is very restricted in France, M. Trousseau is among those who have made use of it in the cases above described, and he speaks confidently of its virtues.

Administration.—The dose of the *powder* of columbo is from ten to thirty grains. In this form it may be usefully associated with carbonate of iron, with the addition of a small quantity of powdered ginger or orange-peel.

An *infusion*, which is officinal, is made by adding half an ounce of bruised columbo to a pint of boiling water. It should be macerated for two hours in a covered vessel and strained. The *dose* is a wineglassful three or four times a day. The British Pharmacopœia directs that cold water should be employed. But spontane-

[1] Essays, Part I. p. 264.

ous decomposition takes place in the cold infusion as readily as in the hot, produced in the former by albumen, and in the latter by starch. A cold infusion, made by displacement, which is officinal, is less liable to these changes; but they may be prevented altogether if the starch is first removed by cold water, and the albumen is afterwards coagulated by boiling the infusion.

The *tincture* of columbo may be used to increase the strength of the infusion, but it is seldom employed alone. It may also be added to effervescent medicines given to check vomiting.

GENTIANA.—Gentian.

Description.—Gentian is the root of *Gentiana lutea*, an herbaceous, perennial plant, which is a native of the southern part of Middle Europe, where it grows in subalpine and mountainous meadows. It is two or three feet high, has a straight, smooth, hollow stem, pale green, opposite, ovate leaves, and large, yellow, pedunculated flowers in whorls. The root, as found in commerce, is in pieces of from several inches to one or two feet in length, of various thicknesses, single or branched, marked with annular wrinkles and longitudinal furrows. Its color is yellowish-brown externally, yellow internally, and the wood is of a spongy texture. It has a feeble, but unpleasant odor, and a very bitter taste. It yields its virtues to alcohol or water. These are supposed to depend chiefly upon *gentisin*, *gentianin* (the latter of which is the bitter principle), and also, to some extent, upon a *volatile oil*. It contains, besides, gum, sugar, mucilaginous matter or pectin, a fixed oil, etc., but neither tannic nor gallic acid. Recent authorities describe two organic principles, *gentiopicrin* and *gentiogenin*, as contained in this root. The former is crystallizable, the latter amorphous. When the greater part of the bitter principle has been removed by alcohol, there remains behind a sweetish extract, which, by fermentation, produces a sort of brandy. The Tyrolese peasants of the Styrian Alps prepare this liquor, which is called spirit of gentian (*Enziangeist*).[1]

History.—Dioscorides first,[2] and Pliny after him,[3] ascribe the first discovery of the virtues of this plant to Gentianus, King of Illyria, from whom it also derived its name. According to the former of these writers, it is stimulant and astringent, a powerful antidote to poisoning by venomous serpents, when taken with wine, pepper, and rue, and also a cure for pains in the bowels, and of bruises. Its root, used as a pessary, is declared to provoke abortion, and its powder or juice is recommended as a dressing for ill-conditioned sores, and as an application in squamous diseases of the skin. Galen declares it to possess attenuant and deobstruent qualities, which he ascribes to its bitterness. An Arabian writer alludes

[1] Pfaff, System der Materia Medica, ii. 28.
[2] Lib. iii. cap. 3.
[3] Lib. xxv. cap. 34.

to a tree under the name of gentian, but states that the plant spoken of by Dioscorides is a shrub. Hobaisch declares it to be an antidote to poisons that have been drunken, to the bites of serpents and scorpions, and venomous animals, and to the wounds inflicted by their teeth or claws. Above all, he adds, "it is that famous medicine whose virtues are so peculiar in cases of mad dogs' bite." It is recommended to be given internally, and that its powder, moistened, should be applied to the wounded part.[1]

Action and Uses.—Gentian is a pure and simple bitter with a very slightly stimulant property. In moderate doses it excites the appetite and strengthens the digestion, without tending to constipate the bowels. When long used, it gives to the sweat and urine a bitter smell and taste, and is then apt to disorder the digestion, and in large doses to cause headache, with injection of the face, and fulness of the pulse. These effects are said to be most readily produced in feeble and sensitive persons, but are probably never observed except when the medicine is taken in excessive doses.

The affections in which gentian is most useful are those in which debility of digestion is the prominent symptom, whether this be caused by protracted illness from idiopathic fevers, by loss of blood, by exhausting suppuration, or by a sedentary life with undue occupation of the mind and a neglect of bodily exercise. It has had a considerable reputation in the treatment of gastric dyspepsia connected with a gouty diathesis, and especially with atonic gout. Boerhaave regarded it as a leading remedy in gout. It is one of the constituents of the *Portland Powder* which was famous as a specific in this disease, and which contained, besides "birthwort (*Aristolochia rotunda*), the tops and leaves of germander (*Chamædrys*), ground pine (*Chamæpitys*,) and lesser centaury (*Chironia centaurium*), in equal parts, powdered and mixed together."

Before the introduction of cinchona it was much used in *intermittent fever*, but, like other simple bitters, it appears to have been serviceable in those cases only which were complicated with atony of the digestive organs, or which assumed the lightest form of this disease, and especially in vernal intermittents. Like other vegetable bitters, it possesses some *vermifuge* properties, and may also be employed, like them, in the treatment of *scrofula*.

Administration.—Gentian may be administered in *powder*, in doses of from ten to thirty grains, but this is a most ineligible form.

The *compound infusion* (Infusum Gentianæ Compositum) is made by the displacement process, with gentian, bitter orange-peel, and coriander seed; alcohol and cold water. The dose of this, which is the best preparation of gentian, is a fluidounce repeated three or four times a day.

The *compound tincture* (Tinctura Gentianæ Composita) is made with gentian, orange-peel, bruised cardamom seeds, and diluted alcohol. This preparation is a very agreeable bitter and an efficient

[1] Ebn Baithar, ed. Sontheimer, i. 260.

stomachic. It is peculiarly adapted to improve the tone of the stomach in persons worn out by habitual drunkenness and debauch. The dose is one or two fluidrachms.

The *fluid extract of gentian* (EXTRACTUM GENTIANÆ FLUIDUM) is prepared by displacement. It may be used when the proportion of alcohol in the compound tincture is thought to be too stimulating.

Extract of Gentian (EXTRACTUM GENTIANÆ) is prepared with water by displacement. In the dose of from ten to thirty grains it exhibits the peculiar properties of the root. It is, however, more generally used as an excipient for other tonic medicines, and particularly for iron and for quinia.

QUASSIA.—QUASSIA.

Description.—Quassia is derived from *Simaruba excelsa*, a tall tree growing in Jamaica and other West India islands.

Quassia wood is generally found in billets, or in raspings or shavings. The first are sometimes a foot in diameter and several feet in length, of a light porous texture, a yellowish-white color, and an intense, pure, and persistently bitter taste. It is without odor.

According to the chemical analyses that have been made of quassia, it contains various alkaline and earthy salts, gum, pectin, and quassin, a bitter principle on which its virtues are supposed to depend. Quassin forms white prismatic crystals, which do not change on exposure to the air, and have no odor, but are intensely bitter. It is soluble in alcohol, and partially so in water.

History.—Quassia wood and flowers are said to have been employed at least as early as the beginning of the eighteenth century by the inhabitants of Surinam, who held them in high esteem as stomachic medicines. The plant is stated to have derived its name from that of Quassi, a negro slave, who first made known its virtues to his master. This account is given by Rolander, who carried the wood to Stockholm in 1756. But the new drug did not acquire popularity until its botanical source was described by Linnæus in 1763.[1]

Action. *On Animals.*—Bergius states that when flies drink of an infusion of quassia they appear benumbed and as if dead, but after a time recover their powers. It is said that the specimens in a botanical herbarium may be protected from insects by dipping the plants in an infusion of quassia, and then drying them, or by placing pieces of quassia wood among them. Even rabbits have been killed by a concentrated preparation of the drug. Härtel saw rabbits destroyed in three days after the application of one or two grains of extract of quassia to a wound in a fleshy part;[2] and Buchner, performing a similar experiment, in two instances found

[1] BERGIUS, Mat. Med., i. 354. LETTSOM, Mem. Med. Soc. Lond., i. 128.
[2] WIBMER, Wirkung, etc., iv. 380.

that death took place within thirty hours. Kurtz observed that a mangy dog, on being washed with a decoction of quassia, lost the use of his hinder limbs for the space of seven hours. Like other bitters, quassia is thought to retard animal decomposition.

On Man.—The intensely bitter taste of quassia has already been noticed. Its internal use excites the appetite, improves digestion, and promotes nutrition, at least when these functions are below the standard of health. But, like other bitter medicines, its excitant influence upon the stomach is not of long duration, and hence it should always be taken a short time before eating. If its use is continued for several weeks, it may occasion, at least where there is a constitutional tendency to plethora, a plethoric state of the system; but it gradually loses its tonic influence as the stomach becomes accustomed to its stimulus. It does not usually occasion either constipation or diarrhœa, but after a time is apt to produce gastric oppression and pain, with nausea, as all other local stimulants do when they are allowed to exhaust the susceptibility of the stomach. Giacomini, for whom and for the whole Rasorian school all tonics are sedatives, performed some experiments with quassia which strikingly illustrate the force of the imagination in therapeutics. Finding himself one day very weak in consequence of his having taken some infusion of quassia upon an empty stomach, he repeated the dose before eating; but this only made his condition worse. He experienced vertigo, dimness of vision, general debility, and feebleness of the pulse, and was obliged to partake of food to renew his strength. On the other hand, feeling oppressed, dull, and disgusted after a full meal, by, as he says, the excessive stimulus of the food, quassia restored his feelings of comfort by reducing the over-stimulation.[1] Scarcely anywhere else than among the writers of the Rasorian school can so singular and perverse a misinterpretation of facts be found.

Uses.—The history of the introduction of quassia into medical practice shows that it was highly esteemed in the treatment of *intermittent fevers* by the inhabitants of Surinam. Even Linnæus asserted that in this respect it far excelled cinchona, and not a few of his contemporaries avowed the same belief. Lettsom, who, very justly, criticized this opinion, nevertheless admits that in some rare cases it will cure the disease when bark has failed to do so. In truth, it possesses as much, and no more, efficacy in this direction than gentian, boneset, chamomile, absinth, etc.—that is to say, the power of curing mild attacks, especially of vernal intermittents.

But it is as a *tonic* and *stomachic* bitter that quassia was first employed, and continues to enjoy a deserved reputation. Whenever the stomach has lost its natural tone after attacks of acute disease, or in consequence of general indolent habits, or, on the other hand, from a want of wholesome, abundant, and appetizing food, or from excessive losses of natural or morbid secretions, quassia is equal, if not superior, to any medicine of its class in reviving the dormant

[1] Mat. Méd., par Mojon, etc., p. 482.

appetite and strengthening the languid digestive powers. In that form of dyspepsia in which vomiting is a frequent occurrence, this medicine will be found peculiarly serviceable, provided that the symptom does not depend upon a textural disease of the stomach. This remark applies not only to simple regurgitation of the food, but also to bilious vomiting with headache, or sick headache, as it is called. In many cases of atonic diarrhœa, and of that form which depends upon the irritation of the colon by retained fæces, the medicine is very serviceable.

Tode speaks of its use in cases of gastric atony attended with spasm of the œsophagus; and Schleger refers to its usefulness in certain cases of vertigo with spastic muscular spasm of the neck, oppressive pain in the head, and ringing in the ears.[1] In an affection somewhat analogous to the latter, described by Bretonneau as depending upon gastric acidity, and marked with vertigo, and a tendency to syncope with sour eructation, quassia with bicarbonate of soda was found of signal advantage.[2] The same may be said of other more evidently nervous or hysterical affections complicated with dyspepsia or depending upon it.

Some of the older writers, among whom Tissot may be mentioned, attribute *anthelmintic* virtues to quassia; and, more recently, Dr. Schultz speaks in praise of its infusion as an injection for the removal of ascarides of the rectum.[3] In the latter case it acts by directly destroying these parasites.

Administration.—Quassia is seldom administered in substance on account of its extreme bitterness. The dose of the *powder* is, however, twenty or thirty grains.

The *infusion* (INFUSUM QUASSIÆ) is made with one hundred and twenty grains of quassia macerated for twelve hours in a pint of water. The hot infusion is stronger, but is more disagreeable than that made with cold water. Quassia cups, or cups made from quassia wood, have been introduced into this country. They are filled with water over night, and their contents drunk in the morning. This invention may be called a medical toy, well adapted to amuse childish patients.

The *extract* (EXTRACTUM QUASSIÆ) is prepared by exhausting with water, and evaporating to a proper consistence. It is a very efficient preparation; but it is better suited for combining with iron, or with laxatives, which should be given in small doses, than for separate use. It may be prescribed in pilular form, or dissolved in Sherry or Malaga wine. The dose of the extract is from two to five grains.

The *tincture* (TINCTURA QUASSIÆ) contains the virtues of two troy-ounces of quassia in two pints of diluted alcohol. It is occasionally called for in low fevers, or during convalescence from acute diseases, but it is seldom used except as an addition to the infusion or

[1] MURRAY, Apparat. Med., iv. 449.
[2] TROUSSEAU and PIDOUX, op. cit., 5ème éd., i. 732, and ii. 380.
[3] Am. Journ. of Med. Sci., June, 1847, p. 175.

decoction of quassia, or of some other bitter tonic. The dose is one or two fluidrachms three or four times a day.

SABBATIA.—Sabattia; American Centaury.

Description.—This is the herb and root of *Sabbatia angularis*, a native annual or biennial plant of the United States. The stem, which is one or two feet high, is smooth and four-sided, with opposite branches, and terminating in numerous flowers, forming together a corymb. The flowers are of a rich rose-color above, but pale in the centre and beneath.

The whole plant is very bitter, but without smell; it yields its virtues to alcohol and water.

Uses.—Centaury may be prescribed in all of the cases for which simple bitters have been recommended in the preceding articles, but it is one of the least efficient of its class. As a popular remedy in intermittent fever its cold infusion has been extensively used in rural districts, but it is too feeble to produce curative effects, except in very mild cases. The hot infusion is sometimes used as a diaphoretic at the commencement of acute febrile attacks. As a tonic it is appropriate during convalescence from sickness, and in slight cases of atonic dyspepsia.

Administration.—The dose of the *powder* is stated to be from *thirty to sixty grains.* It is commonly given in an *infusion* made with an ounce of the plant and a pint of boiling water. Of this a wineglassful, or more, may be directed as a febrifuge every two hours, and as a tonic three times a day.

CHIRETTA.—Chiretta.

Description.—Chiretta consists of the small stalks and roots of *Agathotes Chirayta* (Don), *Gentiana Chirayta* (Roxb.), a native herbaceous plant of the mountains westward of the Ganges, in Hindostan. The whole plant is intensely but not disagreeably bitter, and has no odor. According to the analysis of MM. Lassaigne and Boissel, it contains, besides various salts and gum, a resin and a yellow bitter matter, upon which last its virtues are presumed to depend.

Uses.—The natives of Hindostan hold this medicine to be tonic, stomachic, and febrifuge,[1] and Mr. Twining recommends an infusion of it as a vehicle for the arsenical solution in intermittent fever.[2] According to Mr. Baker it is a "deobstruent" as well as a stomachic medicine, increasing the biliary secretion, and clearing the complexion in jaundiced persons. In scrofula he frequently witnessed its salutary influence.[3] The native practitioners hold it

[1] Ainslie, Mat. Indica, ii. 373. [2] Diseases of Bengal, 2d ed., ii. 218.
[3] Lond. Med Gaz., ii. 685.

to be a remedy for consumption. Perhaps this opinion may arise from its utility in chronic bronchitis, which is attested by Mr. Houlton, in a case where the expectoration was very great, and the powers of the system were very low. He used an infusion prepared with half a drachm (ʒss?) of chiretta to a pint of water.[1]

Administration.—In *powder* the dose of chiretta is twenty grains. An *infusion* may be made with half an ounce of the root to a pint of boiling water; after standing for two hours, it should be strained. It may be given in the dose of from one to three ounces before dinner. Mr. Baker, above cited, states that the natives of Hindostan prefer the *decoction* to the infusion, and make it by gently boiling half an ounce of the dried cut herb in a pint of water for about twenty minutes. Of this decoction the dose is a small wineglassful two or three times a day. The same writer states that the extract of chiretta preserves its virtues perfectly. A *tincture* is prepared according to the British Pharmacopœia by percolation from two ounces of bruised chiretta with sufficient proof spirit to produce one pint. The dose is from one to two fluidrachms.

COPTIS.—Goldthread.

Description.—The root of *Coptis trifolia*, a small evergreen plant with a slender, creeping root, of a bright yellow color, from which its popular name is derived. It inhabits the northern regions of Asia and America, and abounds upon the hills of New England. All parts of the plant are bitter, but the root is intensely so. It is without astringency.

Uses.—Coptis has no special virtues beyond those of the other simple bitters to recommend it, but, in case of need, may be substituted for them. In New England it is popularly used in a wash for aphthous sore mouth, but there is no evidence of its special virtues in this complaint.

An *infusion* may be made with an ounce of the root to a pint of water; and a *tincture* with similar proportions, but substituting alcohol for water. Of the former the *dose* is an ounce, and of the latter a fluidrachm.

XANTHORRHIZA.—Yellow-Root.

Description.—The root of *Xanthorrhiza apiifolia*, a small native shrub of the southern part of the United States. Its slender stem has a smooth bark covering a bright yellow wood, and it bears dark purple flowers in pendulous racemes. Its coloring matter was made use of by the aborigines as a dye. It imparts a drab color to wool, and a rich yellow to silk. The bark of the stem possesses

[1] Med.-Chir. Rev., xxxvii. 205.

the same qualities as the root, which appear to depend upon a bitter gum and resin.

Uses.—Yellow-root is regarded as a simple tonic bitter, and as applicable to the same disorders as the other medicines of its class. It may be used in *substance* in the dose of twenty or thirty grains; it may also be given in tincture or in decoction, but alcohol is supposed to extract its virtues more perfectly than water.

STIMULANT TONICS.

Medicines belonging to this subdivision are distinguished by possessing a certain degree of stimulant as well as a tonic power, the latter depending upon a fixed bitter principle, the former on an essential or volatile oil. In virtue of these constituents, they have also a double action, the one of which is identical with that of pure bitters, and is manifested by their improving the digestion when given in moderate doses, and by their acting as emeto-cathartics when largely administered, especially in the form of warm infusion. The other, due to their essential oil, displays its action upon the nervous system, and through it upon the circulatory and muscular apparatus, especially of organic life, and primarily of the abdominal organs, increasing the contractile power of the stomach and bowels, and augmenting the secretion from the kidneys and the exhalation of menstrual blood from the uterus.

In practice, stimulant tonics are not, like simple tonics, adapted to a prolonged and almost habitual use. Their excitant element is transient in its operation, and their tonic element is comparatively feeble; hence the exhaustion which follows the action of the former is not fully compensated for by the supporting influence of the latter. It is true that all are not alike in these respects, and that in some the tonic quality predominates, while others are little more than stimulants. Indeed, if we review the diseases in which these medicines are reputed to be most beneficial, we shall find them to be such as call for the application of temporary stimulation rather than permanent strength. Thus, in dyspepsia, they are useful chiefly to prepare the way for the more sustained and vigorous operation of pure bitters, or to relieve some special symptoms, such as flatulence or nausea, in cases for which pure stimulants appear to be too exciting. Or if we refer to the other affections in which they are employed, we shall find that, as a rule, the stimulant element of their action is the one upon which their curative operation chiefly depends. This is the case in spasmodic flatulent colic, in suppression or scanty discharge of the menses, and in hæmorrhoids. It is equally so in the treatment of influenza and other forms of bronchitis, acute or chronic, when these medicines become curative. Still more evident is it in those affections which are not seated in

a particular organ, but affect the whole system in one or more of its elements. Thus, is nervous debility, that is, exhaustion with great excitability of the nervous system, stimulant tonics precisely meet the requirements of the disease; in intermittent fevers, in commencing or in chronic rheumatism, in the typhoid state, etc., the tonic element of the treatment is quite subordinate to the stimulant one. The latter is the essential agency, and the tonic influence is of value chiefly because it heightens and sustains the other.

ANTHEMIS.—Chamomile.

Description.—*Anthemis nobilis*, whose flowers are the officinal chamomile, is a native plant of Italy, France, and Spain, but cultivated also in this country, and especially in England, whence it enters largely into commerce. It is a small herb with pinnately-divided pale-green leaves, and flowers with a convex, bright-yellow disk, surrounded by numerous white rays (florets), which become more numerous by cultivation, and gradually usurp the place of the yellow florets of the disk.

Chamomile flowers have a strong and peculiar odor, whence, indeed, they are said to have derived their name (χαμαίμηλον, apple-scented herb), and a bitter and aromatic taste. Water and alcohol extract their virtues. They contain, besides salts of lime and potash, a peculiar bitter principle, resin, and a volatile oil from which they derive their odor, and upon which some of their peculiar virtues depend. It is of a light-green color, which is lost by rectification, and has the characteristic odor of the flowers in a high degree. German chamomile (*Matricaria Chamomilla*) furnishes in a larger, indeed, in nearly double the proportion of the English flowers, a dense, dark-blue, and almost opaque essential oil, which becomes transparent by rectification, but has a less agreeable odor than that obtained from the other plant.

History.—This medicine has been employed from ancient times. The chamomile of Dioscorides and Galen (ἀνθεμίς) is supposed by many to be *Matricaria Chamomilla*, L., which is now used almost as exclusively in Germany as the officinal chamomile, *Anthemis nobilis*, L., is in England and France. Except that the latter is the more active medicine of the two, they may be considered as possessing the same remedial powers.

Among ancient writers, Dioscorides is the first who describes the characters and qualities of chamomile. He speaks of three species, differing only in their flowers. These, with the root and leaves, he pronounces calefacient and attenuant, and states that internally, or applied externally as a fomentation, they promote the discharge of the menses, of the fœtus and the urinary secretion, and the expulsion of calculi; that their infusion is drunk for flatulence, colic, iliac passion, jaundice, and liver complaints, and that their decoction is singularly beneficial as a fomentation in affections of the

bladder. In a cataplasm, chamomile flowers, he says, cure lachrymal fistulæ, and, when chewed, heal ulcers of the mouth. They are also used in clysters with oil, and *in powder as an antiperiodic.*[1] According to Galen, chamomile is peculiarly appropriate for the relief of debility, for alleviating pain, allaying phlegmonous inflammation, mollifying hardened parts, and resolving fevers unattended with inflammation of the internal organs, etc. Nichessor, the Egyptian, says, that oil in which chamomile flowers have been bruised when used to anoint the whole body of a person attacked with fever will excite perspiration if the patient is kept well covered in bed.[2] The Arabian writers repeat this description without many additions, but allude to the essential oil as possessing anodyne qualities, and to the use of the vapors from a hot decoction as useful in the decline of rheumatism.

Action.—The essential oil and the bitter principle of chamomile represent its action on the system. It is a stimulant and tonic. In substance or strong infusion it produces a sense of warmth in the stomach, and, it is said, some acceleration of the pulse. It expels flatus, improves the digestion, does not confine the bowels, and is alleged even to possess emmenagogue virtues. In large doses it occasions nausea, vomiting, looseness of the bowels, pain, with fulness of the head, and it is even said in certain idiosyncrasies to produce a sort of somnolent intoxication with general depression and exhaustion. (*Giacomini.*)

Uses.—At the present day chamomile is chiefly used to improve the *digestive* function when it has become disordered by general disease or by any of the causes that tend to impair its vigor. It is indicated when the process of digestion is rendered difficult and painful by flatulent colic, and more particularly in females and other persons of a nervous temperament. It is one of the best remedies of the tonic class used to prevent the returns of *sick headache*, although, like all the rest, it often fails in this painful and tenacious ailment. Portal has reported a case of long-continued vomiting of black matter, in which an infusion of chamomile with lime-water was used with striking success. Chamomile has also been found to relieve the spasmodic abdominal pains that accompany general susceptibility to cold, and also the menstrual period when the discharge is scanty and light colored. The *emmenagogue* virtues of chamomile are asserted by Dr. T. H. Brown.[3] They are insisted upon by Giacomini. Forestus speaks of the efficacy of the plant in relieving after-pains, and Murray says that chamomile tea is a well-known domestic remedy for this symptom. In *neuralgia* of the fifth nerve, according to Dr. Lecointe, it will sometimes effect a cure when quinia has failed. He reports several cases which appear to sustain his good opinion of chamomile, and insist upon the necessity of giving it in substance in sixty grain doses, or in a very concentrated infusion.[4] According to Ozanam, strong chamo-

[1] Lib. iii. cap. cxxvi.
[2] Matthiolus, Comment.
[3] Am. Journ. of Med. Sci., July, 1855, p. 268.
[4] Bull. de Thérap., xlvii. 556.

mile tea taken in large doses is a powerful means of diminishing and finally arresting excessive suppuration. He thinks that cataplasms of chamomile flowers hasten the result, but are by no means essential to its attainment.[1]

In *intermittent fever* Morton asserted that powdered chamomile in proper doses and at sufficient intervals was not inferior to Peruvian bark. He, however, combined it with antimonial powder and salt of wormwood;[2] Pitcairn and Hoffmann were of the same opinion, but Cullen, in citing it, states that if the flowers are given in large quantity, they run off by stool, and defeat the purpose of administering them.[3] Voigtel says that in those forms of intermittent fever which are only founded in atony and congestion of the abdominal organs, and require for their removal volatile as well as permanent stimulants, and "which therefore are not cured by cinchona," chamomile is one of the most efficient remedies.[4] So M. Dubois states that he cured a tertian ague, which had resisted sulphate of quinia for three months, by daily doses of sixty grains of powdered chamomile. He also cites Wauters, Bodart, Chaumeton, and Masius as having been equally successful.[5] It is, indeed, asserted[6] that this remedy is inefficient in the treatment of miasmatic intermittents; but it is simply begging the question to presume that all who have vaunted chamomile as a remedy for intermittent fever from the time of Dioscorides to the present day, have been mistaken in regard to the nature of the disease which they cured. It has been stated elsewhere that many cases of simple intermittent fever, especially of the vernal form, recover under the influence of good nursing or a change of air alone. Many of these, it is to be presumed, recover still more rapidly if treated by chamomile or by any stimulant bitter; but there remain not a few cases, like some cited above, in which chamomile cures after bark has failed to do so, and in these it is impossible to deny that the former medicine has accomplished what the latter could not perform. If it be said, as it has been, that these are cases of an idiosyncrasy rebellious to bark, the fact may be admitted, but it does not disprove, but rather establishes, the antiperiodic virtue claimed for chamomile.

It is probably not a matter of indifference in what form the remedy is administered. In all of the cases referred to above the powder was exclusively employed. Sometimes it is given in the form of hot infusion upon the approach of the paroxysm, and in such a manner as to promote diaphoresis; or again, when there is gastric or bilious derangement, copious draughts of warm chamomile tea may be directed so as to induce free vomiting followed by perspiration. But in both of these cases whatever there may be specific in the medicine is not brought into operation.

[1] Bull. de Thérap., liv. 42.
[2] Murray, App. Med., i. 215.
[3] Mat. Med., ii. 78.
[4] Syst. der Arzneim., iii. 432.
[5] Mat. Méd. Indigène, p. 126.
[6] Trousseau and Pidoux, op. cit., 5ème éd., ii. 489.

The *emetic* properties of chamomile, one of the applications of which has just been referred to, may be invoked whenever it is desirable to evacuate the stomach without depressing the system, as in cases of so-called biliousness, when the stomach is overloaded with food, and also, after a debauch, or at the commencement of an attack of *delirium tremens*. The warm infusion is also an excellent drink to be given after more active emetics, or with them, in order to render their operation more prompt and certain.

Externally the *oil* of chamomile has been applied by friction to painful rheumatic parts, and to the abdomen when distended with flatus. It has been applied to the auditory canal for the relief of *earache*. But more commonly fomentations made with chamomile flowers soaked in hot water or an alcoholic liquor, or poultices of flaxseed meal made with a strong infusion of chamomile, are used to assuage local pain arising from intestinal or uterine *colic*, rheumatism, neuralgia, *earache*, toothache, abscess, etc., or to cleanse foul and gangrenous *ulcers*. Dr. Erasmus Wilson says, "We entertain a strong belief that the perfume of chamomile is destructive of the acarus scabiei, and we use it accordingly in our pomades for the treatment of *scabies*. Bazin was wont to recommend for the same purpose an unguentum anthemidis; and an Italian journal reminds us that an infusion of chamomile flowers has been recommended as a wash for the skin as a protection against gnats."[1]

Administration.—In the form of *powder* chamomile may be prescribed in doses of twenty grains three time a day as a tonic, and as an antiperiodic, in doses of sixty grains at like intervals.

The *infusion* (INFUSUM ANTHEMIDIS) is made with half an ounce of chamomile to a pint of boiling water. The cold infusion is more agreeable, but is also less efficient. The dose is a wineglassful or two before meals. As an emetic not less than a pint of the warm infusion should be prescribed.

The *extract* is not officinal; it possesses none of the volatile oil of flowers, and does not, therefore, fully represent them as a medicine. It is, however, a good bitter tonic in the dose of from five to twenty grains. In preparing pills with this substance, a small quantity of the oil of chamomile may be added, for the purpose of rendering them more efficient. A *fluid extract* is prepared, a fluidrachm of which represents thirty grains of chamomile flowers.

The *oil* of chamomile is sometimes prescribed as a stimulant carminative, in doses of five or six drops, upon sugar, in ether, or in Hoffmann's anodyne, or in pills made with crumbs of bread.

EUPATORIUM.—THOROUGHWORT; BONESET.

Description.—The leaves and flowering tops of *Eupatorium perforatum*. This is an indigenous, perennial, herbaceous plant which abounds in every part of the United States, usually growing by the

[1] Journ. of Cutaneous Med., iii. 103.

margins of small streams. The stems are erect and branched above: the leaves, which are long and narrow, are opposite, and united at their bases so as to appear perforated by the stem, whence the specific name of the plant, *perforatum.* The adjacent pairs are in parallel planes, but are at right angles with one another. The flowers are white and feathery, and are arranged in dense terminal corymbs.

The virtues of eupatorium appear to reside in its leaves and flowers, which have a very bitter but peculiar taste. They are yielded to water and to alcohol. An attempt was made in 1813 to determine upon what principles the sensible qualities of the plant depend, by Dr. A. Anderson, of New York. In his inaugural thesis he endeavored to show that it contains tannin, resin, gum, etc.[1] More recently a substance called *eupatorine* has been obtained under the form of a dark brown resin of a slightly aromatic odor and somewhat bitter taste.

Action and Uses.—Eupatorium is closely analogous to chamomile in its effects, a stimulant tonic in small quantities, a laxative in large doses, and an emetic and diaphoretic when administered copiously in warm infusion. Its diaphoretic action is, indeed, conspicuous in many circumstances. It was first brought into notice by the aborigines of this country, who are said to have employed it in *intermittent fever.* In 1803 it was known to be popularly used for the cure of this affection,[2] and its use in *yellow fever* was advocated by Mr. Stevens, and even by Dr. Hosack.[3] Their hopes in regard to it proved unfounded. In intermittent fever it was and continues to be a popular domestic remedy. Dr. Anderson published six cases of its successful use, and was of opinion that it might supersede Peruvian bark and other ordinary remedies. But subsequent observation has greatly narrowed the grounds of its reputation, and the general sentiment is now in accordance with that of Eberle, who says: "The result of my own experience does not lead me to form a very high opinion of it as a remedy in intermittents. I have known it to remove the disease in a few instances by producing vomiting and copious perspiration."[4] Administered in this manner on the accession of the paroxysm, in vernal intermittents especially, and during the apyrexia in the form of cold infusion, it will doubtless generally cure them. In mild cases of autumnal intermittent fever, occurring remote from a focus of malaria, it may also sometimes succeed, as well as in cases which have proved intractable to quinia. Like others of its class, however, eupatorium must hold a very humble place among the antiperiodic medicines.

It is much more useful in the treatment of acute muscular *rheumatism*, and of epidemic catarrh, or *influenza.* Its diaphoretic virtues are sufficient to put an end to an attack of the former disease, if given at an early stage; and probably the tonic influence of the cold infusion would, like that of cinchona and other bitters, pro-

[1] An Inaugural Dissertation on the Eupatorium Perfoliatum of Linnæus, p. 49.
[2] Stevens, Med Repository, vii. 12. [3] Med. Essays, iii. 434.
[4] Mat. Med., 6th ed., p. 463.

mote the return of health. The utility of the medicine in influenza is thought to have been early recognized, and its popular name of *boneset* was perhaps acquired by its relieving the distressing "pains in the bones" which distinguish this disease. It was more probably, however, given in consequence of its beneficial effects in the cold stage of intermittent fever, when such pains are often extremely severe. However this may be, it is stated by Anderson to have proved highly serviceable in the influenza of 1807. In an epidemic at Petersburg, Va., in 1843, Dr. Peebles employed it with very satisfactory results.[1] The pain in the back and limbs, and the lassitude of the general muscular system, subsided as soon as the system was placed under its influence; it induced a healthy and free discharge of perspiration, restoring the natural color and tone of the skin, and at the same time allayed the cough, promoted expectoration, and removed dyspnœa. The patient having been covered up in bed, a warm infusion of the medicine was given in wineglassful doses every half hour. After the fourth or fifth dose considerable nausea, sometimes vomiting, with free diaphoresis and expectoration, ensued, and there was an immediate amelioration of the symptoms. From this time, unless there was a relapse, the medicine was given only every third hour, in the same dose. Generally on the fourth day the patient was able to go out. During convalescence a wineglassful of the cold infusion was given three times a day.

In the "typhoid pneumonia" which prevailed from 1812 to 1814 it is said to have been salutary; and more recently was "extensively employed among the negroes on the plantations in South Carolina as a tonic and diaphoretic in colds and fevers, and in the typhoid pneumonia so prevalent among them."[2]

As a *tonic*, eupatorium is not as acceptable to the stomach as chamomile, yet its cold infusion may be used for all the purposes for which medicines of its class are prescribed. Dr. Bigelow speaks favorably of it, saying that it "promotes digestion, strengthens the viscera, and restores tone to the system." Dr. Eberle thought it peculiarly adapted to the relief of indigestion in very old people; and Dr. Burgon used, with evident benefit, the cold infusion "in cases of anorexia consequent to drunkenness."

Administration.—Eupatorium is seldom exhibited in *substance*, but the dose of the powder may be stated at twenty or thirty grains.

The *infusion* (Infusum Eupatorii) is the usual form in which eupatorium is administered. It is prepared by macerating an ounce of the herb in a pint of boiling water for two hours, in a covered vessel, and straining. Of this, the dose as a tonic is one or two fluidounces taken cold, three or four times a day, but more frequently as an antiperiodic. As an emetic, the infusion should be given warm in doses of half a pint; and as a diaphoretic, in doses of a fluidounce or two every half hour until nausea occurs or the proposed effect is induced.

[1] Am. Journ. of the Med. Sci., April, 1844, p. 362.
[2] Dr. F. P. Porcher, Trans. Am. Med. Assoc., ii. 791.

ANGUSTURA.—ANGUSTURA.

Description.—The bark of *Galipea officinalis*, a small tree of South America. In commerce it occurs in quills and in flat pieces covered with a soft epidermis of a grayish-white or yellow color. The internal surface is brownish-yellow, fibrous, and laminated. It has a peculiar and somewhat offensive odor, and a bitter, slightly aromatic, and persistently acrid taste which excites salivation. Powder of Angustura resembles that of rhubarb in color.

There is contained in this bark a bitter crystallizable principle, *cusparin*, with a *bitter hard resin*, a *balsamic soft resin*, *volatile oil*, *gum*, and *woody fibre*. It yields its properties to alcohol and water.

A bark closely resembling this, and sometimes found mixed with it in commerce, is known as *false Angustura*. It is that of *strychnos nux vomica*, and is intensely poisonous. The leading differences between it and true Angustura bark are these: its quills or flat pieces are twisted, its epidermis is of a rust color, it is not laminated, emits but little odor, has a persistently bitter taste, and its powder is of a very pale yellow color.

History.—In 1759, Mutis published at Madrid that Angustura bark was used by the inhabitants of the Spanish colonies with great success as a remedy for fever and dysentery. It was brought to England in 1788, where for some time it was held in great esteem. But in 1804, numerous cases of poisoning having occurred with symptoms like those produced by strychnia, and which were traced to the admixture of the bark of the nux vomica tree with the true Angustura, the latter fell into disrepute, and has ever since been but little employed even in Europe, and still less in the United States. Nevertheless, it possesses qualities which seem to entitle it to favor as a medicine.

Action.—Angustura bark is held to resemble cascarilla in its operation, but it is less stimulating, and more analogous to the pure bitters. If the stomach is irritable, it is apt to occasion nausea and vomiting. It is sometimes compared to cinchona, but it has less astringency.

Uses.—Like the other bitters, it has been used very successfully in many cases of *intermittent fever*, of a mild type; and Winterbottom declared it to be equally efficacious with cinchona in the treatment of *remittent fever* at Sierra Leone, and even preferable as a tonic towards the decline of the attack. He also used it with advantage in the cure of intermittents.[1] Hancock, Williams, and Wilkinson have also spoken of it favorably. M. Bretonneau, on the other hand, found it wholly insufficient for the cure of cases presenting a regular type, and of several weeks' duration.

In *low fevers* it has been usually employed under the same circumstances as Peruvian bark, particularly in those attended with diarrhœa, great debility, and adynamic symptoms generally.

[1] Med. Facts and Obs., vii. 41.

Under such circumstances, Lettsom thought it superior both to cinchona and serpentaria.[1] When these symptoms characterize *epidemic dysentery*, the medicine appears to have been employed with marked advantage by the natives of Angustura and especially in the typhoid and chronic cases of this affection.

In ordinary cases of asthenic *dyspepsia*, especially those in which flatulence predominates, it has been found of service.

Administration.—Angustura bark may be given in powder, in doses of from ten to thirty grains. The *infusion* (INFUSUM ANGUSTURÆ) is made, by displacement, with half a troyounce of the bark, so as to procure a pint of liquid, and may be given in the dose of two fluidounces. It may also be prepared by macerating Angustura in a pint of boiling water for two hours, in a covered vessel, and straining.

CASCARILLA.—CASCARILLA.

Description.—Cascarilla is the bark of *Croton Eleuteria*, a small tree which is a native of the Bahama Islands and Jamaica. In commerce it generally occurs in quills, or in pieces from one to four inches long, and half an inch or less in diameter. It is hard and heavy, with a resinous fracture; the epidermis is whitish, from being covered with lichens, and irregularly fissured, but the true bark is of a dark-brown color. Its taste is bitter, warm, and spicy, and its smell, when it is warmed, is aromatic, and when burned, very much like that of musk.

Alcohol and also water extract its virtues, which are supposed to depend upon a volatile oil and a bitter crystallizable matter, *cascarillin*, and bitter extractive matter. It does not contain any astringent principle.

History.—Cascarilla (a diminutive of the Spanish word *cascara*, and meaning little bark), according to Pomet, was brought to France from South America, in 1670,[2] by M. Legras; and in 1684, Stisser described its aromatic taste and smell, and referred to its being frequently mixed with Peruvian bark.[3] The same Stisser published a book in the year 1693, in which he states that a portion of the bark had been given him by an Englishman of some celebrity, and that he had made tinctures of it, and tried its medicinal powers in calculous affections, in asthma, phthisis, and scurvy; that he had reason to be satisfied with his success, and adjudged it to be diuretic and carminative.[4] At that time it was used to mix with smoking tobacco, to which it imparted an aromatic fragrance and taste, and as a medicine in intermittent, hectic, and malignant fevers, dysentery, and flatulence of the bowels.

[1] Mem. Med. Soc. Lond., iv. 193.
[2] Hist. des Drogues, Appendice à la 3ème partie.
[3] HOFFMANN, Oper. Om. suppl., ii. 705.
[4] SIGMOND, Lancet, 1837–38, i. 575.

Action and Uses.—The properties of cascarilla are stimulant rather than tonic, and its fumes when inhaled have a very sensibly intoxicating effect. The infusion excites a pleasurable feeling of warmth in the stomach, but in a large quantity occasions nausea, colic, and diarrhœa.

It was originally given in *intermittent fever* associated with cinchona, for the purpose of correcting the astringent operation of the latter, while it appeared to enhance its febrifuge powers. It was also used to render the bark more acceptable to the stomach. Like other bitters, it sometimes has cured intermittents of a mild type. Its more frequent use, however, was to produce a stimulant effect in *low fevers* and *dysentery* of the same type, or of the chronic form, when they prevailed epidemically. It was then either given alone or as an adjuvant to cinchona. Its use in such affections is perhaps too much neglected at the present day, when it is seldom prescribed except as a stomachic stimulant tonic in cases of *atonic dyspepsia* attended with flatulence, or with frequent vomiting of the food, either alone or associated with other medicines of the same class.

Administration.—The dose of cascarilla in *powder* is from ten to thirty grains. The *infusion* (INFUSUM CASCARILLÆ) is made by percolation with a troyounce of the coarsely-powdered bark, so as to procure a pint of liquid: or by macerating the cascarilla in a pint of boiling water for two hours, in a covered vessel, and straining. It may be given in doses of two fluidounces, two or three times a day.[1]

[1] CUNDURANGO.—In 1871 the American minister to Ecuador communicated to the Secretary of State of the United States, the alleged discovery in the former country of a specific cure for cancer. The government of the former country courteously forwarded to the Secretary a quantity of the reputed specific with a statement of the method of using it. Soon afterwards the Surgeon-General of the Navy instructed Passed Assistant-Surgeon Joseph G. Ayers to collect botanical specimens of cundurango and such information relating to it as it might be possible for him to obtain. This gentleman executed his commission with great zeal and ability, and its results are embodied in a "Report on the Origin and Therapeutic Properties of Cundurango, by W. S. W. Ruschenberger, M.D., Medical Director U. S. Navy," from which these and most of the following details are derived.

Of ten plants called cundurango, one only, white cundurango, is that which for a time acquired so much notoriety as a remedy for cancer. It is a vine from ten to thirty feet in length, and from one to two inches in diameter. The leaves are very large and of a dark green color. The flowers are small, and arranged in umbels. The fruit consists of a pair of dehiscent pods, five inches in length. The bark, which is the medicinal portion, is imported in quills, or semi-cylindrical pieces, from one-sixteenth to one-sixth of an inch thick. The liber is yellowish-white, and, in transverse section, presents numerous minute yellow points. Its taste is bitter and aromatic, and when dried, it is without odor. No volatile oil or acid is obtainable from it by distillation; nor is any crystalline alkaloid or active principle separable by analysis. It contains, however, about three per cent. of a yellow resin, and an extractive which, together with tannin and coloring matter, form nearly one-sixth of its solid vegetable constituents.

Botanical condurango forms a new genus. Dr. Ruschenberger proposes "that it be called Pseusmagennetus equatoriensis (from ψευσμα, a lie, a fraud, and γεννητης, a parent, a producer)," a name suggested, we conjecture, by the unusual amount of fraudulent misrepresentation which accompanied the attempt to introduce it into medical practice.

The statements which reached this country from South America respecting its power of curing cancer, immediately suggested to every well-instructed physician

MARRUBIUM.—Horehound.

Description.—Horehound (*Marrubium vulgare*) is a perennial herbaceous plant, which grows in Europe in hilly and stony localities, and by roadsides. It is fully naturalized in this country. It is remarkable for its white cottony stalk and leaves, its aromatic and somewhat musky smell, and its bitter and spicy taste. It contains a bitter extractive with an essential oil, some resin, and a little tannic acid, and yields its virtues to water and alcohol. The leaves and tops are used in medicine.

History.—Dioscorides gives a full account of this plant, whose leaves or juice, he says, are, when taken with honey, very serviceable to those who have asthma, cough, or consumption, it being eminently efficient as an expectorant. He states that it promotes the discharge of the placenta and of the lochia, favors conception, and is an antidote to the bite of venomous serpents, but that it irritates the kidneys and bladder. It is further useful as a detergent and astringent of ulcers.[1] To this description Galen adds that it is a deobstruent of the liver and spleen; and Pliny mentions it as good for strumous tumors when applied in an ointment, with honey for affections of the genital organs, and with vinegar in lichenous eruptions. He dwells particularly on its value in pulmonary complaints.[2] This application of the medicine is strongly insisted upon by Alexander Tralles, Cælius Aurelianus, and the Arabian writers, who also specify the dyspnœa in which it is most useful as that produced by an accumulation of mucus in the air passages. They recommend its decoction to be given internally, and cataplasms containing the leaves to be applied to the chest. The latter application is also advised in flatulent colic. The value of the juice in inflammations of the eyes, opacity of the cornea, and ulcers of the eyelids or of the cornea, is hinted at by the Greek, but strongly expressed by the Arabian authorities.[3] Its influence on jaundice, connected with enlargement of the liver, has been asserted by many writers, such as Zacutus Lusitanus, Chomel, and Forestus;[4] and some cases of dropsy, associated with hepatic disease, are also said to have been cured by its use.[5] These citations are sufficient to show in what esteem horehound was formerly held, and if it has now fallen into disuse, except as a domestic remedy, the reason must be looked for in the number of more powerful remedies which the Materia Medica possesses at the present day.

Action and Uses.—Horehound may be regarded as a stimulant tonic, and as therefore applicable to all cases of *gastric atony*, besides

grave doubts of their authenticity or of their truth, or of both at once; and the first reports of its effects in this country by their very exaggeration more than confirmed the original impression. It is unnecessary to follow the brief career of this imposture, since the plant which occasioned it no longer possesses a claim to higher virtues than are exhibited by various other aromatic bitters.

[1] Mat. Med., lib. iii. cap. cii.
[2] Hist. Nat., lib. xx. cap. lxxxix.
[3] Ebn Baithar, ed. Sontheimer, ii. 251.
[4] Alston's Mat. Med., ii. 172.
[5] Murray, App. Med., ii. 196.

which it appears to have a special relation to the pulmonary mucous membrane, and by its stimulant operation to reduce and improve the secretions from this part. The popular use of horehound candy seems to show a general confidence in its virtues, which in that form, however, must be altogether insignificant. The expressed juice of the fresh plant taken with milk has been recommended by Dr. Griffith in *chronic bronchitis*. It was the juice that was particularly esteemed by the ancients, and recent testimony is not wanting to show that its virtues are substantial. Horehound has also been used in chronic rheumatism, hepatic and uterine disorders, as an anthelmintic, to arrest salivation, and in intermittent fever.

Administration.—In *powder* the dose of horehound is from thirty to sixty grains. An *infusion*, made with an ounce of the plant to a pint of hot water, may be taken in wineglassful doses. The *expressed juice* may be given in doses of one or two fluidrachms, three or four times a day, with honey or with milk. A *syrup* is sometimes made which, like the candy already referred to, cannot have very active properties. In Europe an *extract* is prepared which is prescribed in doses of ten or fifteen grains every two or three hours.

ACHILLEA.—Yarrow; Milfoil.

Description.—Yarrow (*Achillœa Millefolium*) is a perennial herb indigenous to Europe but naturalized in this country, where it is largely cultivated by the Shakers. It grows in the fields, on the roadsides, and among heaps of rubbish, and blooms in summer and early autumn. "It is about a foot or eighteen inches high, and is distinguished by its doubly pinnate, minutely divided leaves, and by its dense corymb of whitish flowers." It has a feeble aromatic odor, which is stronger in the flowers than in the herb, and an aromatic, somewhat bitter and acrid taste. The bitterness is most marked in the leaves. Griffith states that the American is stronger than the European plant. It yields a volatile oil which is most abundant in the flowers, and a bitter extractive which abounds in the leaves, with tannin, etc. Zano announced as its active principles, *achillein* and *achilleic acid*. It imparts its properties both to water and alcohol.

History.—This plant was employed by the ancients as a medicine, and is said to have derived its specific name from Achilles, whom it cured of a wound. Dioscorides recommended it as a remedy for ulcers and fistula, and for hæmoptysis; Galen as a vulnerary; Arnold of Villanova, Riverius, Trnka, Stahl, and Mellin in hæmorrhoidal affections; Stahl in portal congestions, Hoffmann for after-pains, and Fuchs in menorrhagia.

Action and Uses.—Yarrow is regarded as a stimulant tonic, and appears to possess virtues that entitle it to be so. Besides improving the digestion, and, in impressional persons, quickening the circula-

tion, it may, in large doses, produce a sort of intoxication (vis narcotica, inebrians, *Linn.*). That it exerts an elective influence upon the pelvic viscera can hardly be doubted when it is considered that the most evident of its curative effects are manifested in uterine and hæmorrhoidal affections.

Like all the plants of its class yarrow can claim to have cured some cases of *intermittent fever*, but in this respect it has but a slender title to our confidence. Nor is it very efficient as a stomachic in cases of *gastric debility*. In *nervous* affections it has always been used with reputed success. In regard to *hæmorrhoids*, the case is different. Besides the authors named above who have found it an efficient remedy, others may be cited nearer to our own time. Hufeland thus describes the particular conditions of its success: "In certain cases the discharge is mucous and not bloody. The patient experiences tenesmus and other hæmorrhoidal symptoms, or has previously had bleeding piles. . . . . The treatment consists in restoring the bloody discharge, or employing the general remedies which hæmorrhoidal disease calls for, or in making use of bitter resolutives and tonics, *especially the infusion of milfoil*, with ferruginous preparations."[1]

Teissier employed it with great advantage in cases of the same description, and when, in the absence of organic diseases of the rectum, there was a discharge of mucus and blood, a state which, he well remarks, induces, sooner or later, extreme debility and a cachectic condition.[2] In a case of this nature, with numerous hæmorrhoidal tumors, discharges of blood, mucus, and albuminous coagula, with prolapsus of the rectum, the writer employed it, to the manifest advantage of the patient, although complete relief was obtained only by a surgical operation.

The influence of the medicine as a remedy for *menstrual* derangements is still more marked. Like many reputed emmenagogues, it appears to be useful in restoring the catamenia to a normal state, both when they are suppressed or scanty and when they are profuse. M. Ronzier-Joly quotes the following passages from an essay by Valmont de Bomare: "Milfoil is employed internally and externally to arrest all sorts of hemorrhages; . . . but women and maidens affected with bleeding piles ought not to continue its use too long, lest it produce a suppression of the catamenia." Dr. B. H. Coates used the infusion of this plant with material advantage in two cases of hemorrhage from the kidneys, three (in the same patient) from the uterus, and one from the lungs.[3] Several other writers have reported similar results. But Voigtel says that it is not less indicated in the opposite condition, when the irregularity or suppression of the menses depends upon debility;[4] and M. Ronzier-Joly has published several cases which go to prove that the medicine is sometimes very efficient in re-establishing the suppressed

[1] Med. Prat. par JOURDAN, p. 383 [2] Bull. de Thérap., iii. 170.
[3] Trans. Philad. Coll. of Phys., Dec. 1854, p. 334.
[4] System der Arzneim., iii. 426.

menses, if it is duly administered at the catamenial period.[1] He also states that in two cases he employed it successfully in restoring the lochial discharge, as Manoury has also done in the last century.[2] M. Richart, of Soissons, who, like some of the physicians mentioned above, found milfoil useful in relieving uterine colic in young girls at the establishment of puberty, also employed this remedy as a stimulant in epidemics of *measles* and of *scarlatina* in which the eruption was backward or imperfect. He prescribed the infusion as a drink and as an injection, and also had the patient placed in warm baths impregnated with the herb. It might be supposed that the apparent efficacy of the treatment was due to the warm water of the baths rather than to their medicinal ingredient; but they, as well as other means, had been tried previously, and failed. The same method was used successfully in cases of convulsions occurring during dentition.[3]

Many cases of *leucorrhœa* and of *flatulent colic* are reported to have been cured by this remedy.

The infusion has also been recommended as a gargle in relaxation of the *uvula* and *pharynx*, and as a wash for *sore nipples* and other ulcerated surfaces.

Administration.—An *infusion*, made with half an ounce of the tops of the plant in half a pint of water, and reduced by heat to six ounces, may be given by tablespoonfuls every hour. The *expressed* juice is prescribed in doses of one or two fluidounces three times a day. The *volatile oil* may be prescribed in the doses of twenty drops.

CALAMUS.—Calamus.

Description.—Calamus is the rhizome of *Acorus Calamus* or sweet flag, a native perennial plant of the United States, of Europe, Egypt, and India, where it grows in damp and marshy situations. The leaves are radical, long, flat, and ensiform, and of a reddish color below. The flower (spadix) is bobbin-shaped, about two inches long, and terminates in a tuft of greenish-yellow florets. The root, or rhizome, which is sometimes several feet in length and half an inch or more in thickness, and jointed, runs horizontally near the surface of the ground. It gives off numerous radicles. When dried and prepared for sale these are removed, and the rhizome itself is much shrunken. It is of a light and spongy texture, yellowish-brown externally, and of a white or pinkish-white color within.

The odor of calamus is very agreeable, and it has a warm, aromatic, pungent, and somewhat bitterish taste. These qualities of the root appear to depend upon a volatile oil, a resinous principle, and ex-

[1] Bull. de Thérap., lii. 260, 313, 550; lv. 361.
[2] Anc. Journ. de Méd., xxxiv. 402 (1770).
[3] Abeille Méd., Mai, 1850.

tractive matter, and they are much impaired by keeping. It yields its virtues to boiling water.

Action and Uses.—Calamus excites a sense of warmth in the stomach, promotes the appetite, and improves the digestion. It is said also to quicken the pulse and increase the secretions of the skin and kidneys. In large doses it is reported to stimulate the circulation unduly and occasion headache.

It is used as an ingredient of infusions of bitter tonics in those cases of *dyspepsia*, or torpor of the stomach, especially with flatulence, which call for stimulants, and in numerous chronic affections in which this state of the digestive organs depends upon general atony of the system. Ainslie informs us that it is a very favorite medicine of the East Indian practitioners, and is reckoned so valuable in the indigestions, *colics*, and bowel affections of children, that there is a penalty incurred by any druggist who will not open his door in the middle of the night and sell it if demanded.[1] On the Malabar coast a bath made with an infusion of the root is considered an efficacious remedy for epilepsy in children. The Arabians and Persians place it among their aphrodisiacs and carminatives. The Turks candy the roots, and regard them as a preventive against contagion. Like other stimulant tonics, it has been used successfully in mild cases of intermittent fever, and is not to be neglected as an adjuvant to bark and quinia. As a stimulant it may be employed with profit in typhus fever, and in the typhoid state of various febrile affections. It has also been thought to have peculiar virtues in chronic gout.

Administration.—*Powdered* calamus may be given in doses of from twenty to forty grains or more. The root also may be chewed habitually as a remedy for the dyspeptic symptoms mentioned above. An *infusion* made by digesting an ounce of calamus in a pint of water may be prescribed in the dose of two or more fluid-ounces. A *fluid extract* and a *syrup* of calamus have also been prepared.

AURANTII AMARI CORTEX.—Bitter Orange Peel.

AURANTII DULCIS CORTEX.—Sweet Orange Peel.

Description.—Orange-peel is the dried rind of the fruit of *Citrus vulgaris* and *C. aurantium*. The former is the bitter, and the latter the sweet orange. In commerce orange-peel is found in elliptical concavo-convex pieces, or in thin parings, and retaining more or less of the pithy white substance which unites the rind to the pulp. The first-named variety is the more active as a medicine, as it contains a bitter principle, and also, in common with the other variety, an

[1] Mat. Indica, i. 417.

essential oil which abounds in the follicles of the rind. Orange-peel yields its virtues to alcohol and water.

History.—The orange tree is a native of Eastern Asia, but was introduced into the Levantine countries early in the Christian era, and into Spain by Juan de Castro in 1520. It was thence transported to the West Indies and the adjacent portions of the American continent. Orange-peel was employed by the Arabian physicians, who reputed it to be stimulating, and an excellent remedy for colic, and also for intestinal worms.[1]

Action and Uses.—Orange-peel has an aromatic smell, and a warm, pungent, and bitter taste. It stimulates the digestive organs, and produces in the stomach a grateful sense of warmth like other substances of the aromatic class. The oil would appear to be endowed with very active properties. At Clermont Ferrand, in the South of France, the China orange is very largely cultivated for the sake of its rind. The persons employed in removing it are singularly affected. Their hands become inflamed with an erythematous, a papular, or a vesicular eruption; they suffer from headache, dizziness, tinnitus aurium, deafness, neuralgia, oppression in breathing, constriction of the throat, nausea, pyrosis, eructations, and thirst. They are disturbed by dreams, experience twitching and cramps of the muscles, and sometimes epileptiform convulsions. All of these symptoms disappear when the occupation that caused them is abandoned.[2] M. Imbert-Gourbeyre, who furnishes this account, states that he has employed the essential oil with success as a remedy for *hysterical* and other nervous affections.

Orange-peel is employed in medicine chiefly to qualify the operation of pure bitters, and thereby to obtain a speedier and more decided impression, or to render those medicines more acceptable to the stomach. Like the aromatics, it is sometimes associated with purgative medicines that are apt to gripe, or when the bowels are distended with flatus. The peel of the sweet is preferable to that of the bitter orange for the latter purpose.

Administration.—Orange-peel is generally prescribed as an addition to infusions and decoctions. In the latter case the bruised peel should be added after ebullition has terminated, and in the proportion of three to four drachms to a pint of the liquid. The *confection* (CONFECTIO AURANTII CORTICIS) is made by beating recent sweet orange-peel, grated, with sugar. A *syrup* (SYRUPUS AURANTII CORTICIS) made with an alcoholic tincture of sweet orange-peel forms an agreeable addition to bitter infusions and other stomachic preparations of that nature. A *tincture* (TINCTURA AURANTII) made with bitter orange-peel is officinal. A *compound tincture* of orange-peel (*Elixir aurantiorum compositum*, Ph. Bor.) prepared by digesting in Madeira wine, cinnamon, carbonate of potassa, and extracts of gentian, absinth, water trefle, and cascarilla, is much used in Germany as a stomachic.

[1] EBN BAITHAR, ed. Sontheimer, ii. 545.
[2] CANSTATT's Jahresbericht für 1853, p. 158, from Gaz. Méd. de Paris.

ANGELICA.—Angelica.

Description.—Angelica (dismissed from the fifth edition of the Pharmacopœia) is the root of *Angelica Archangelica*, a native plant of Lapland, Norway, and the mountainous regions of Central Europe. It is also cultivated as a garden plant in many parts of that country, and, occasionally, in the United States. The stem, which is four or five feet high, is hollow, fluted, of a bright green color, and very fragrant, as are also its large doubly pinnated leaves, and its flowers arranged in large umbels of a greenish-white color. The root is large, fleshy, very aromatic, and in the spring season furnishes, on incision, a musky juice.

Candied angelica stalks are sold by confectioners and are a favorite preserve, but the root only is employed by druggists. It consists of a cylindrical head with numerous long and stout radicles. Externally its color is grayish-brown, but it is white within. It has a strong and peculiar but not disagreeable odor, and a bitter and persistently acrid taste. Its properties are extracted by alcohol, and less perfectly by water. They depend chiefly upon an essential oil, a peculiar acid, bitter extractive, and various minor constituents.

History.—In the middle ages this medicine was very highly prized, and its very name indicates a belief in its celestial virtues. In the North of Europe, where it most abounds, it was peculiarly esteemed. The Laplanders are said to be very fond of its green shoots as a salad, and they preserve the mature stalks as a seasoning for food, and as a remedy in pulmonary complaints. They also use a decoction of the buds in whey as diaphoretic, stomachic, etc. The Norwegians employ the root for similar purposes.[1] In the English edition of Pomet[2] it is stated that the seed is used to make angelica comfits, and the stalk is a very good sweetmeat candied. "It is cordial, bezoartick, and alexipharmick, heats, dries, opens, and attenuates, causes sweat, resists poison, and cures the bitings of venomous creatures . . . . . besides which, it provokes the terms, expels the birth, resists poison, helps suffocation of the womb, cures palsies, apoplexies, convulsions, cramps, and rheumatisms." To this Lemery adds that it is used in the plague and malignant fevers and for the bites of mad dogs.

Action and Uses.—Angelica possesses the properties of a stimulant tonic, but is more stimulant than tonic. It has been compared to senega and also to serpentaria, like both of which it may, in large doses, act as a diaphoretic or an emetic. But it appears to have a closer resemblance to calamus.

As a medicine, angelica has been used chiefly to combat the symptoms of the *typhoid state;* and in the convalescence from acute diseases. Hildenbrand preferred it (as being an indigenous remedy) to serpentaria in typhus, and states that he had used it with the

[1] Murray, App. Med., ed. alt., i. 373.
[2] A Complete History of Drugs, 3d ed., 1737, p. 39.

greatest success in hundreds of cases of this disease.[1] But it is probably in the less decidedly adynamic states which attend the convalescence of febrile affections, and when some agreeable and stimulant tonic is required to revive the vigor of the stomach, that angelica is most directly indicated. Yet, apart from its more grateful taste, which must be admitted to present advantages, it is not easy to perceive its superiority over chamomile and other similar remedies. The vogue which angelica enjoys as a domestic remedy for *catarrhal* affections, and particularly for those of aged and feeble persons, makes it probable that it is really of value in these diseases, under the same circumstances indeed in which senega is usually prescribed. As the latter medicine is nauseous, the substitution of angelica for it, in the cases referred to, might be advantageous.

In *rheumatism*, *gout*, *intermittent fever*, etc., angelica is said to have been sometimes beneficial.

Administration.—Angelica root may be given in *powder*, in doses of from ten to thirty grains every two or three hours. An *infusion* made with white wine or water, in the proportion of a pint to an ounce of the root, may be used in doses of a teaspoonful every two or three hours.

Angelica Atropurpurea.—This is an indigenous species of angelica, somewhat resembling the European. Its name is derived from the purplish color of its stem. When recent, the root is acrid, and is said to be poisonous; but when dried it is used as a carminative and stimulant. Like the foreign plant, the stems of this species are sometimes candied. Still another indigenous species, A. lucida, is said to possess aromatic qualities similar to those above described.

The following stimulant tonics are treated of in other divisions of this work:—

HUMULUS,	vid.	*Narcotics.*
SERPENTARIA,	"	*Diaphoretics.*
MYRRHA,	"	*Antispasmodics.*
ABSINTHIUM,	"	*Anthelmintics.*
TANACETUM,	"	"

TONIC AND AROMATIC STIMULANTS.

A NUMBER of the medicines belonging to this class are in common use under the general title of aromatics, or spices. All are vegetable products, and are furnished by the natural families Labiatæ, Synanthereæ, Umbelliferæ, Laurineæ, etc. They contain volatile

[1] Du Typhus Contagieux, p. 213.

oils, and several of them a bitter or acrid principle in addition. The former are often separated by distillation, to be employed in a pure state; diluted with alcohol, they belong to the *Spirits* of the Pharmacopœia.

The properties which these medicines possess in common are those of local and general stimulants, with a greater or less, but always subordinate, degree of tonic power. Two of them only, sage and rue, approach by their bitterness to the articles of the preceding class. Applied externally, they act as rubefacients, as in the familiar example of the spice-plaster, or poultice. As internal stimulants their action is first denoted by their sharp, biting, and warm taste, the irritation they produce in the fauces, and the sense of warmth which they excite in the stomach, a sensation which often seems to diffuse itself throughout the whole abdomen, while the action of the heart is quickened in a sensible degree. Perhaps this effect is produced through the medium of the sympathetic nerve, for there is nothing to indicate that the brain or spinal marrow participates directly in the excitation when these articles are administered in medicinal doses. Their influence is restricted to the alimentary canal, or, in the case of certain of them, to several other abdominal organs. Thus rue and milfoil are believed to be emmenagogue, cinnamon is said to be an excitant of the gravid uterus, and cubebs and parsley are regarded as diuretic. Many, especially of the Labiatæ, act as stimulant sudorifics when given in warm infusion, while sage, as an astringent, tends to diminish excessive perspiration from debility.

We have said that, in ordinary doses, medicines of this class, in their natural state, do not affect the brain, but when their essential oils are administered in large quantities the effects are marked, and may even, in some instances, be fatal. A sort of intoxication, resembling that of alcohol, is usually produced, accompanied or followed by general prostration, coldness, and insensibility. But the different agents produce somewhat different effects, and those of nutmeg are peculiar in being decidedly narcotic.

The most common application of aromatic medicines is their use as corrigents of food which might disagree with a weak stomach, or of medicines which tend to occasion nausea. For the former purpose they are much more generally employed by the cook than by the physician. They enter into the composition of many of the cakes and confections dear to youthful palates, and thus mitigate the evils of overloading the stomach with such mischievous productions. In this country ginger and cinnamon are the ordinary condiments of these preparations, but in Germany anise, cumin, and caraway are the favorites.

Associated with other medicines, aromatics are very useful to disguise the taste of those which are offensive to the palate, and the odor of such as have a repulsive smell; they also, by their own agreeable odor and flavor, render even tasteless and scentless preparations attractive to the fastidious or the whimsical. Very often the stomach will not retain certain substances which irritate it

mechanically or otherwise excite nausea, unless it is stimulated, and perhaps its sensibility at the same time obtunded, by preparations of the aromatic class. It is probably the latter influence which renders these medicines so useful as corrigents in purgative compounds. Nearly all cathartics may occasion more or less pain during their operation, and opiates are often associated with them to palliate this inconvenience; but, as they likewise counteract the purgative action, they are less eligible than aromatics, which stimulate rather than diminish the peristaltic movements of the intestine. They are, however, contra-indicated when an inflammatory condition of this organ, or of the peritoneum, exists.

Aromatic stimulants are in ordinary use as carminatives, or medicines which expel flatus.[1] A singular notion has prevailed that the pain of flatulent colic is owing to spasm of the intestine, and that carminatives relieve the one by relaxing the other. But the least consideration demonstrates that pain from flatus, whether in the stomach or in the colon, is produced by an over-distension of these parts, for no sooner does the gas escape than the pain is relieved. Debility of the intestine is the condition in which flatulent colic is most apt to occur. Stimulants become carminatives because they excite the gastro-intestinal canal to contraction, and thus provoke the expulsion of the distending cause. In addition to this, they probably exert an anodyne or soothing influence on the nerves of the alimentary canal, and render it less susceptible to the irritation of its contents. As a general rule, the concentrated forms of these medicines, and in particular their essential oils, are the most appropriate for exhibition in flatulent colic. When sickness of the stomach exists, they may be mixed with olive oil and employed as an embrocation for the abdomen; or the fresh herb of the plant, when it can be procured, may be bruised and applied as a cataplasm to the same part. It should be remembered that carminative medicines do not, in general, remove the cause of the flatus which they expel. This, which may arise from the decomposition of food, or from a secretion into the bowels induced by defective innervation, requires for its cure evacuants or antizymotics in the one case, and in the other tonics and astringents.

Their action upon the nervous system explains the common use of these medicines in various affections characterized by irregular and spasmodic action of the muscles, such as hysterical dysphagia, hiccup, spasm of the gall-duct and ureters, and some forms of dysuria and dysmenorrhœa. But in all of these disorders, except the first two, narcotics are more efficient remedies. Several of the class (cinnamon, rue, pennyroyal, rosemary) are thought to possess a specific power of exciting contraction in the gravid uterus, or, in gene-

[1] "Carminare signifies to assuage with verses (*carminibus*): for the ancients thought that poets, by means of their verses, could assuage pains and too vehement motions."—BOERHAAVE, *Powers of Medicines*, p. 303. From carminare, also, comes the English word *charm*. Of these medicines, which sometimes act very promptly, it is usual to say "they act like a *charm*."

ral terms, of stimulating this organ. Another, black pepper, is supposed to possess antiperiodic qualities.

Many stimulants contain an acrid principle which acts as an irritant when they are applied to the skin. This is strikingly the case with horsemint, ginger, black pepper, cajeput, and some others. Hence these substances, or the essential principles derived from them, are often used when local stimulant, counter-irritant, and anodyne impressions are desired in combination. Such conditions are presented in cases of flatulent colic, already noticed, in neuralgia, and in subacute and chronic rheumatism, particularly of the form which affects the muscles exclusively.

ANISUM.—Anise.

Description.—Anise is the fruit of *Pimpinella anisum*, a small annual plant, and a native of Egypt, Syria, and Greece, but cultivated in many parts of Europe, and occasionally in this country. The seeds, or fruit, are oval, about a line in length, striated, downy, and of a yellowish-brown color. They have a fragrant odor, and a sweet, warm, and aromatic taste. These properties are due to a volatile oil which is contained in the envelope of the seeds, and is separated by distillation. They impart their qualities to water, but more perfectly to alcohol. Oil of anise is whitish or yellowish, and has in an intense degree the smell and taste of the seeds. It is much employed in the manufacture of a cordial known as *anisette*.

History.—Anise was well known to the ancients. Dioscorides says it sweetens the breath, is diuretic and resolvent, and assuages the thirst of the dropsical. It resists the poisons of venomous creatures, is carminative and binding; restrains leucorrhœa, excites the secretion of milk, and is aphrodisiac.[1]

Action.—Strumpf found that oil of anise destroyed rabbits in a less dose than six drachms. Somewhat less than three drachms given to a young cat occasioned palpitation of the heart and exhaustion, and constipation which continued for two days. The urine was discharged as usual, and the animal evinced much thirst. A single drop of the oil placed upon the skin of a canary bird under the wing, excited signs of pain followed by lethargy and insensibility, and death in four hours. The body resisted putrefaction for six weeks. Two or three drops rubbed on a sparrow's head rendered it dull for several hours.[2]

Uses.—Anise is used to expel flatus and relieve the pain caused by its distension of the stomach. It is said, also, to promote expectoration in chronic catarrhs. It is often used to mitigate the griping of purgatives, such as senna, rhubarb, and jalap.

Administration.—From ten to twenty grains of bruised anise may be given at a dose. Or an infusion, made with from 120 to 180 grains of the bruised seeds in half a pint of boiling water, may be

[1] Lib. iii. cap. lvi. [2] Handbuch, i. 611.

directed in tablespoonful doses. Oil of anise (OLEUM ANISI) is given in the dose of from two to six drops on sugar, or in sweetened water. Spirit of anise (SPIRITUS ANISI) is administered in the dose of a fluidrachm.

ASARUM.—CANADA SNAKEROOT.

Description.—This is the root of *Asarum Canadense*, a small perennial plant, indigenous to the United States and Canada, and growing in shaded woods, especially in hilly situations. As found in the shops, the root (rhizome) is in small contorted pieces about as thick as a quill, frequently furnished with short fibres, wrinkled and browish externally, but whitish within, and of a hard brittle texture. It has a spicy, bitter taste, which is thought to resemble that of cardamoms, and, when fresh, it also has an agreeable aromatic smell. The powder of the dried leaves is a powerful errhine. This root yields its properties to water, but more completely to alcohol. They appear to depend upon an essential oil (which is fragrant and of a light color), and an acrid and a bitter resin.

Uses.—Canada snakeroot is an aromatic stimulant, with some tonic qualities. Its warm infusion, like that of other medicines of the same class, is diaphoretic. It is popularly employed to relieve flatulent colic, and has been used medicinally as a substitute for serpentaria in diseases of a typhoid type.

Administration.—The powdered root may be given in doses of twenty or thirty grains; or the infusion, made with half an ounce of the root and a pint of boiling water, may be prescribed in doses of a wineglassful. Dr. Wood has suggested the preparation of a tincture by macerating four ounces of the root in two pints of diluted alcohol, to be used as an addition to tonic infusions.

OLEUM CAJUPUTI.—CAJEPUT OIL.

Description.—This medicine is the volatile oil of *Melaleuca Cajuputi*, a small tree of the Molucca Islands, belonging to the natural family of Myrtaceæ. Its name, in the language of the natives, signifies *white tree*, and serves to indicate the white bark for which it is remarkable. The oil is obtained from its leaves by distillation in copper vessels, and, according to Guibourt, it always contains a trace of this metal, which communicates to it the greenish tinge which is peculiar to it. But this statement has not been confirmed. It is very fluid and transparent, has a hot, aromatic taste, followed by a sense of coolness in the mouth, and a strong but agreeable odor, which is said to resemble that of turpentine, camphor, peppermint, and rose, together. It is wholly soluble in alcohol.

History.—Cajeput oil was first brought into notice in 1717, by

Locher. According to Rumphius, it is employed in Amboina, and the neighboring countries, as a stimulant diaphoretic.

Action and Uses.—When swallowed, cajeput oil excites a sense of warmth in the stomach, quickens the pulse, and increases the perspiration and the urine. The Malays are in the habit of prescribing it internally in epilepsy and palsy, and, according to Ainslie,[1] it is a highly diffusible stimulant, antispasmodic, and diaphoretic, and may be efficaciously given in dropsy, chronic rheumatism, palsy, hysteria, and flatulent colic.

Cajeput oil is used internally as a remedy for *flatulent colic*, particularly when it is produced by cold or by the retrocession of inflammations, gouty or otherwise, of the skin or extremities, and when the *menses* are suspended or diminished, and attended with pain, under the influence of similar causes. In choleraic affections of the same origin it is equally efficient. In some spasmodic affections of hysterical persons, and particularly in cases of *nervous vomiting*, *nervous dysphagia*, *dyspnœa*, and *hiccup*, it is of marked utility. It has also been used as a vermifuge.

As a local rubefacient stimulant it is employed diluted with olive oil, in cases of functional *paralysis* and *muscular rheumatism*. With almond oil it is applied on cotton to the auditory canal for the relief of *deafness*. It forms one of the best remedies for *toothache* depending upon caries, when a drop of it on cotton is introduced into the hollow tooth; and a few drops rubbed upon the painful part form a remedy for *nervous headache* that is often effectual. It is a useful stimulant in chronic *scaly affections of the skin*.

Administration.—Internally cajeput oil may be given in doses of from two to ten drops, on sugar, or with Hoffmann's anodyne, or with the tinctures and infusions of other antispasmodic medicines. When used as a vermifuge, it may be mixed with honey in the proportion of one part in thirty or more, and given in dessertspoonfuls every hour or two. It may also be administered by enema.

CINNAMOMUM.—Cinnamon.

Description.—Cinnamon is the bark of *Cinnamomum Zeylanicum*, and of *C. aromaticum*. The former is a native of Ceylon, whence it has been introduced into the Malabar country, and into Cayenne and Brazil. The tree is about thirty feet high, and its smaller branches afford the bark of commerce. It is in the form of quills of various sizes, the smaller being introduced into the larger, and from two to three feet or even more in length. The bark is smooth, about the thickness of wrapping paper, of a dull yellowish-brown color, has a splintery fracture, and is easily reduced to powder. It has a warm, sweetish, aromatic, and somewhat astringent taste, and a very agreeable and delicate odor, qualities which it owes to an essential oil. Besides the oil, of which it yields

[1] Mat. Ind., i. 261.

six parts in a thousand, cinnamon contains tannin, resin, cinnamic acid, etc. *C. aromaticum* is a native of China. Its officinal portion, which is the inner bark, is known in commerce as *cassia.*

History.—Cinnamon appears to have been known to the ancient nations inhabiting the countries bordering upon the Levant. It is the κινναμωμον of Herodotus, a name which he states the Greeks learned from the Phœnicians. This name seems to be derived from the Cingalese *Cacynnama* (dulce lignum), or the Malay *Kaimanis* (*Royle*). It is spoken of in the Hebrew Scriptures;[1] in the Hippocratic writings it is mentioned as a remedy for after-pains; Pliny refers to it as a costly aromatic used in burning the dead,[2] and states that it is brought from Central Africa. Dioscorides describes five or more varieties of cinnamon, and says that it is diuretic, emmenagogue, and ecbolic, and acts as an antidote to poisons, and to the bites of venomous animals. He adds that with honey it removes freckles from the face, that it is useful in catarrhs, dropsies, diseases of the kidneys, and dysuria.[3] Galen and Paulus Ægineta remark that it is highly desiccative. The Arabian writers attribute to cinnamon the virtues that have been mentioned, and others besides. Sofia, of Andalusia, asserts that it renders the voice clear when it has become hoarse from mucus in the air passages, and that it diminishes secretion from these parts and from the posterior fauces, and indeed from all of the organs. It is even serviceable, he declares, in anasarca and ascites. Rhazes says that it promotes digestion, and relieves pain in atony of the stomach, and recommends that for these affections it should be mixed with the food. He adds that it has a tendency to occasion flatulence and excite erections. Avicenna refers to its astringent qualities, and Galen, like Dioscorides, and other ancient writers, distinguishing between cinnamon and cassia, says that the latter may be employed when the former cannot be procured, but in double the dose.[4]

Action. *On Animals.*—Mitscherlich showed, in his experiments upon rabbits, that these animals are killed in five hours by a dose of six drachms of the essential oil of cinnamon. The symptoms produced by it were violent action of the heart, hurried respiration, anxiety, evacuation of solid fæces, debility, insensibility, slow and labored respiration, coldness of the extremities, and death. The gastro-intestinal mucous membrane was not inflamed, but in many places was abraded, and here and there points of effused blood existed in the glandular layer of the membrane. The odor of cinnamon having been very perceptible in the breath of the animals during the experiments, and in the urine as well as in the peritoneal cavity after death, it is probable that the effects depended upon the absorption of the oil and its influence on the nervous system, rather than upon its local action on the digestive organs.

On Man.—When oil of cinnamon is rubbed upon the skin it occasions slight redness and a pungent heat; but these effects are

[1] Exodus, xxx. 23.
[2] Hist. Nat., xii. 41.
[3] Mat. Med , i. xiii.
[4] Ebn Eaithar, ed. Sontheimer, i. 404.

transient. When swallowed, the oil, and also the powder of cinnamon in a less degree, excite a sense of warmth in the stomach, and a temporary increase of the appetite and digestive power. If its administration is continued, constipation of the bowels ensues. In all inflammatory states of the gastro-intestinal mucous membrane it is to be avoided.

Uses.—Cinnamon water and oil of cinnamon are much employed to give an agreeable flavor to medicinal compounds and to render them acceptable to the stomach. The slight astringency of the former renders it peculiarly appropriate as a vehicle for more actively astringent medicines, while its stimulant properties tend to expel the flatus and to alleviate the pain which are the usual attendants of *diarrhœa* produced by cold or by irritating ingesta. If the bowels contain none of these, or if they have been removed by a laxative, the chalk mixture (*Mistura Cretæ*) of which cinnamon water is the excipient, and to which the tincture of catechu, or laudanum, or both, may be added according to the predominance of diarrhœa or of colic, is one of the most common and useful of prescriptions.

In Germany cinnamon has long been regarded as peculiarly adapted to control *uterine hemorrhages* and to promote *contraction of the distended uterus.* Van Swieten asserts that he found the tincture useful in the former; and Plenck says that he had very frequently used it in these affections, during, as well as after labor, and in the non-gravid state, and that he believed it to be as really a specific for uterine hemorrhage as cinchona is for ague.[1] Mursinna, also, while he disapproves of its use during pregnancy, attributes to it the greatest efficacy during labor and when hemorrhage depends upon atony of the uterus.[2] Richter, speaking of the general esteem in which the medicine is held, says that whenever uterine hemorrhage becomes excessive and produces exhaustion, or even threatens life, whether it be from profuse menstruation, or during pregnancy or labor, or after delivery, it is customary to have recourse to cinnamon. He, however, would restrict its use to atonic hemorrhages in the non-gravid state, and those depending upon a flaccid state of the uterus after delivery, and he affirms that it is especially serviceable on account of its property of promoting contractions of the uterus.[3] Sundelin furnishes precisely the same account,[4] and Vogt does not suggest a doubt of its accuracy,[5] but more recent writers, as Clarus and Œsterlen, appear to be sceptical upon the subject. Yet Werber more recently presents as favorable an opinion as any before him of its efficacy in arresting uterine hemorrhage and promoting uterine contraction.[6] In England, although less known, tincture of cinnamon was recommended by Dr. Gooch as one of the ingredients of a mixture in menorrhagia; Dr. Rigby places cinnamon in the same group with ergot and borax; and more recently Dr. Tanner found it useful in moderating the

[1] Murray, App. Med., iv. 438.
[2] Ibid., p. 440.
[3] Ausfür. Arzneim., iii. 120.
[4] Heilmittellehre, ii. 200.
[5] Pharmakodynamik, ii. 635.
[6] Heilmittellehre (1856), i. 308.

menstrual discharge in cases which did not appear to depend either upon plethora, anæmia, or uterine organic disease. He also found that it seemed to increase the severity and rapidity of the pains of labor, and to diminish the loss of blood.[1] More recently still M. Teissier has furnished an equally favorable account of the hæmostatic virtues of this medicine.[2] After referring to its successful employment by Schmidtmann, Frank, and Gendrin, he states that in menorrhagia depending upon chlorosis or anæmia it is superior to all other hæmostatics when administered during a few days preceding the menstrual period; that in hemorrhage preceding, accompanying, or following labor in women of lax tissue and feeble circulation, and who are subject to irregular menstruation and chronic leucorrhœa, he has found it of decided advantage; and finally that it is one of the best means of moderating the exhausting hemorrhages caused by cancer of the womb.

These various testimonials appear to leave no doubt in regard to the reality of the virtues claimed for cinnamon; and while it would be irrational to give it the precedence of ergot and of ergotine in the several conditions alluded to, it possesses advantages as a stimulant which render it more peculiarly appropriate in those cases for which iron is the more certain but less prompt constitutional remedy.

Administration.—*Powdered* cinnamon may be prescribed in doses of from ten to thirty grains. The *tincture* (TINCTURA CINNAMOMI), and the *spirit* (SPIRITUS CINNAMOMI), are given in doses of from one to four fluidrachms. The *oil* may be directed in doses of from one to three drops, diffused by means of finely-pulverized sugar in water; or the officinal *cinnamon water* (AQUA CINNAMOMI) may be substituted for it in the dose of from half a fluidounce to a fluidounce. An extemporaneous *infusion* of cinnamon is often made with two drachms of the bruised bark to a pint of boiling water, and given in doses of two or more tablespoonfuls. It also forms an important ingredient of the *aromatic powder* (PULVIS AROMATICUS), in which it is associated with ginger, cardamom, and nutmeg. This preparation is given in doses of from ten to thirty grains. When inclosed in a flannel bag, and moistened with hot brandy, or, after the addition of hot spirit, rendered tenacious by means of molasses or honey, cinnamon forms one of the most soothing applications that can be made to the abdomen in cases of flatulent colic or cholera morbus. The *aromatic confection* (CONFECTIO AROMATICA), which also contains cinnamon, is sometimes prescribed for the relief of flatulent colic and of simple diarrhœa.

CANELLA.

Description.—The inner bark of *Canella alba*, a tall tree which is a native of Jamaica and other West India islands. It occurs in

[1] Lancet, Oct. 1853, p. 363. [2] Bull. de Thérap., xlix. 76.

quills from a few inches to two feet in length, which are derived from the smaller branches, and are often twisted; they are of a pale or grayish-orange color externally, but whitish on the inner surface, brittle, with a granular fracture, and have an agreeable aromatic smell like that of cloves and nutmegs, and an acrid, bitterish, and pungent taste. The pieces of canella are sometimes taken from the bark of the trunk or larger branches, in which case they are coarser, thicker, and darker on the exterior, and not so much quilled as the other variety.

Canella contains a volatile oil, resin, and bitter extractive, the last of which it yields to water, but the others more perfectly to alcohol.

Action and Uses.—As might be expected from its composition, canella is both tonic and stimulant, and may be employed whenever there is gastric debility without organic cause. It is seldom used alone, but is frequently associated with other tonics, and also with some purgative medicines whose operation is debilitating, or which have a local action which it is designed to augment. Of the former description are jalap and scammony, and of the latter aloes.

Administration.—The dose of canella, in *powder*, is from ten to forty grains. Its association with aloes is officinal (PULVIS ALOES ET CANELLÆ), and has been extensively used as an emmenagogue in doses of from ten to twenty grains. Canella is an ingredient of the *wine of rhubarb* (VINUM RHEI), a cordial laxative in doses of from one to four fluidrachms; and also of the *wine of gentian*, a stomachic tonic, which is given in doses of from half an ounce to an ounce.

CARYOPHYLLUS.—CLOVES.

Description.—Cloves are the unexpanded flowers of *Caryophyllus aromaticus*, a native tree of the Molucca Islands, but also now extensively cultivated in Sumatra, the Mauritius, Bourbon, the West India Islands, and South America. The flowers are composed of a tubular calyx, divided superiorly into four lobes, and supporting a corolla of four petals, which in its unexpanded state has a globular form. These flower-buds, which have the appearance of a small nail (*clou*, Fr.), are about half an inch long, of a dark-brown color externally, but reddish within; they have a strong and fragrant smell, and a hot, aromatic, somewhat bitter and persistent taste.

Cloves contain eighteen per cent. of a volatile oil, besides tannin, gum, and resin, and a crystallizable principle probably derived from the oil. Their active properties are completely extracted by alcohol, but imperfectly by water. The oil is white, yellowish, or brownish, and has a penetrating smell, and a fiery aromatic taste.

History.—Cloves were unknown to the ancient Greek and Latin medical writers, and the first who mentions them is Paulus Ægineta, (A. D. 634), who speaks of them chiefly as condiments. The Arabians were well acquainted with their source and characters. They

regarded them as emmenagogue, and aphrodisiac, and as fitted to promote conception; as carminative, also, and adapted to allay vomiting; as a suitable condiment to prevent flatulence arising from vegetable food; as useful to strengthen spongy gums and to sweeten the breath, to promote digestion, to expel tænia, to cure atonic diarrhœa and anasarca, and to relieve coryza when bruised and applied to the forehead.[1]

Action and Uses.—Moderately used, cloves, like other aromatics, stimulate the digestive function, but gradually exhaust the susceptibility of the stomach, and occasion loss of appetite and constipation. The oil acts as a diffusible stimulant when taken in a somewhat diluted state, but in large doses and undiluted is a powerful irritant.

Cloves are rather a condiment than a medicine for internal use, and hence are commonly employed to season food containing much fat, or which is otherwise indigestible. An infusion of cloves may be given to allay nausea, or to relieve the pains of flatulent colic. They are sometimes chewed in cases of paralysis of the tongue or cheek as a local excitant; they are an ingredient of the spice plaster (*Pulvis aromaticus*), which is an excellent anodyne in flatulent and nervous colic; they enter into several formulæ for dentifrice; the oil is frequently applied on cotton to carious cavities in teeth with a view of allaying pain, and sometimes to the interior of the auditory canal in cases of deafness from nervous debility.

CARDAMOMUM.—Cardamom.

Description.—The officinal cardamom is the fruit of *Elettaria Cardamomum*, which grows abundantly on the Malabar coast of Hindostan. It is a perennial plant, from six to nine feet high, with long lance-shaped leaves, and a rhizome with long fleshy fibres, which lies near the surface of the ground. The seed-pods are about half an inch in length, three-sided, obscurely rounded at the ends, longitudinally wrinkled, and of a buff color. The seeds are small, brown, irregular, and rough upon the surface, and easily reduced to powder. The odor of cardamoms is fragrant, the taste warm, pungent, aromatic, and somewhat terebinthinate. Its virtues depend upon a volatile oil which is obtained by distillation from the seeds. They also contain a fixed oil.

History.—Cardamom is mentioned as a medicine by Hippocrates and Dioscorides, the latter of whom states that it grows in India, and speaks of it as a remedy for epilepsy, sciatica, paralysis, sprains, colic, worms, etc. etc. But Matthiolus gives many reasons which appear satisfactory, against believing this medicine to be the officinal cardamom of the present day,[2] while Mr. Adams thinks there is no reason for doubting that it is so.[3] Undoubtedly neither

[1] Ebn Baithar, ed. Sontheimer, ii. 281.
[2] Comment. sur Dioscoride, i. 5.
[3] Commentary on Paul. Ægin., iii 157.

the Asiatics, among whom the plant is native, nor the European physicians who have lived and practised among them, attribute to cardamom any other virtues than belong to stomachic stimulants in general.

Uses.—Cardamom is a warm and agreeable carminative and stomachic, which is well adapted to form an addition to tonic and stimulant preparations. The compound tincture, on account of its brilliant red color, imparted by cochineal, as well as from its active properties, is a favorite remedy for flatulent colic, when mixed with hot water and sweetened. Among the medicines of its class none is perhaps superior to it in acceptableness to the palate, as well as to the stomach.

Administration.—Cardamom may be administered in an *infusion* made with from sixty to two hundred and forty grains in a pint of boiling water, and given in the dose of a wineglassful. In Germany white wine is sometimes used instead of water as a menstruum. There is a *simple tincture* (TINCTURA CARDAMOMI) and a *compound tincture*, containing caraway, cinnamon, and cochineal, (TINCTURA CARDAMOMI COMPOSITA), either of which may be prescribed in doses of one or two fluidrachms.

CARUM.—CARAWAY.

Description.—Caraway *seeds*, as they are commonly called, are the fruit or mericarps of *Carum Carui*, a small biennial umbilliferous plant which grows wild in Europe, and is also cultivated there and in this country. They are of a brownish color, from one to two lines in length, pointed at either end, slightly curved inwards, with a convex back and flattened sides, and are marked with five yellowish longitudinal ridges. They have an aromatic smell, and a warm, spicy, and somewhat bitter taste. These qualities are derived mainly from an essential oil, which, when first distilled, is colorless, but becomes darker, and finally brownish by age. It is soluble in alcohol and ether, but only slightly so in water.

History.—Caraway is described by Dioscorides, who attributes to it diuretic and stomachic properties like those of anise.[1] The same qualities are ascribed to it by Galen, Paulus, and the Arabians, one of whom adds that it possesses anthelmintic virtues.[2] Pliny states that it derives its name from its native country, Caria, and that it is chiefly used in the culinary art.[3]

Action and Uses.—Mitscherlich found that oil of caraway is a strong poison for rabbits, half an ounce of it destroying life in the course of five hours. The death of the animals was preceded by increased frequency of the pulse and respiratory movements, loss of sense and motion, and death by gradual asthenia. No structural

[1] Mat. Med., lib. iii. cap. lvii.
[2] EBN BAITHAR, ii. 368.
[3] Hist. Nat., xix. 49.

changes existed in the primæ viæ, but the odor exhaled from the peritoneal cavity indicated absorption of the oil.

Caraway is more used by the confectioner than by the physician; but it may be employed in flatulent colic, and whenever a gastric stimulant or a carminative is required. An infusion, and a water of caraway, may be prepared in the same way as those of anise and fennel-seed, and the oil (OLEUM CARI) may be applied, like that of cloves, to assuage the pain of toothache when the nerve pulp of the tooth is exposed, or may be taken in ether, Hoffmann's anodyne, or sweetened water, in doses of from one to ten drops.

CORIANDRUM.—CORIANDER.

Description.—*Coriandrum sativum* is a small, annual, umbelliferous plant, a native of Asia Minor and Southern Europe. The fruit, or coriander *seed*, as it is usually called, is spherical, about two lines in diameter, of a grayish-brown color, ribbed, and formed by the junction of two half fruits. It has when dry an aromatic and somewhat sweetish smell, and a similar taste. Coriander seeds furnish an essential oil which is very liquid, colorless, and of the same taste and smell as the dried seeds.

History.—Hippocrates regarded coriander as stimulant and stomachic, but Dioscorides declares it to be sedative. Hence he says that mixed with cataplasms it is a useful application to erysipelatous parts and herpetic ulcers, carbuncles, scrofulous swellings, and all active inflammations. These remarks seem to apply to the herb, for it is added that the fruit (seeds) macerated in wine is anthelmintic, and promotive of the spermatic secretion, and that if too much of it is taken, the mind may become disturbed.[1] He states further that coriander is readily recognized by its smell (which Matthiolus compares to that of bed-bugs, and hence, indeed, its name, from κορις, cimex), and that a decoction of it may produce a delirium resembling that of drunkenness; for those who are under its influence talk indecently, and reveal what poison they have taken by the odor exhaled from their persons.[2] Galen seems to have been much irritated by the opinion of Dioscorides as to the sedative and discutient properties of the plant, and, indeed, characterizes it bluntly as false. He, however, explains it by a reference to the astringent qualities of the plant, which, he admits, are competent to produce the effects ascribed to them by Dioscorides. But, he says, at the same time, that it is not at the height of inflammation that coriander, or any similar application, can do good, but only when, the inflammatory process having declined, stimulants are required to restore the normal action of the part. The Arabian writers are altogether with Dioscorides and against Galen in this argument, although most of them, like Avicenna, admit the medicine to possess a transient stimulant operation. Rhazes and

[1] Mat. Med., iii. 62. [2] Ibid., vi. ix.

Hobaisch speak of its expressed juice as a poison, and the latter mentions pains, anxiety, syncope, and constriction of the throat among the symptoms it produces. Elgâfaki also mentions delirium, disturbance of the memory and understanding, and usually sleep, as consequences of an overdose of it, and he includes it in the same group with opium and cicuta.[1] In modern times Hoffmann has stated, on the faith of some monks, that it is capable of producing intoxication.[2] Whatever degree of truth there may be in these accounts, which seem to refer exclusively to the herb and not to the seeds of coriander, there is no reason to suppose that the latter possess any qualities but those of the carminative aromatics.

Action and Uses.—Coriander seeds appear to be simply aromatic and stimulant. They are seldom employed in medicine, except as a corrective to purgative medicines which are apt to gripe. For this purpose they form an ingredient of the *infusion* and of the *confection of senna*, of the *tincture of rhubarb and senna*, the *tincture of senna and jalap*, etc. The dose of coriander is from thirty to sixty grains.

CUBEBA.—*Cubebs.* Vid. *Diuretics.*

FŒNICULUM.—FENNEL.

Description.—Fennel is the fruit of *Fœniculum dulce.* It has become naturalized, and is cultivated in Europe, and also in this country. It is an umbelliferous plant, and its seeds or half fruits are oblong, flat on one side, convex on the other, five-ribbed, and of a dark grayish-green color. They have a fragrant smell, and a sweet and aromatic taste. The properties of fennel-seed depend upon an essential oil of a light color and agreeable flavor.

History.—Fennel-juice and the root and seeds are frequently mentioned in the Hippocratic treatises as remedies for jaundice, and as means of promoting the secretion of milk, the lochial discharge, etc. Dioscorides, besides ascribing to them these and other virtues, says that a decoction of the tops is diuretic, and an infusion in cold water arrests vomiting.[3] Both he and Pliny describe a wild and a cultivated variety. The last-named author states, among other things, that fennel was an ingredient of most of the compound condiments of his time, and that then, as is now the custom, especially in Germany, the seeds were strewn over the surface of bread and cakes. He mentions that it is much esteemed in diseases of the lungs and liver; that a decoction of the root is diuretic, discutient, and alexipharmic; that the whole plant is aphrodisiac, etc.[4] Galen repeats the same statements, and adds that it promotes the lacteal secretion, and is an emmenagogue. Arabian writers state that the seeds are more heating than the leaves, but that the latter

[1] EBN BAITHAR, ed. cit., ii. 372.
[2] MURRAY, App. Med., i. 405.
[3] Lib. iii. chap. lxvii. lxviii.
[4] Hist. Nat., xx. xcv.

possess a more anodyne virtue, and that the curative powers of the root excel those of the other parts. Avicenna says that it quickens the digestion; and, according to others, a decoction of the seeds, besides being carminative, has also expectorant virtues, and relieves dysuria.[1]

Action and Uses.—The operation of fennel-seed is the same as that of the carminatives generally. It stimulates the digestive function, and, according to Mitscherlich, increases the renal, cutaneous, and mucous secretions, and also that of the milk. Six drachms of the volatile oil were required to destroy a rabbit; and the animal perished after symptoms of distress, followed by general insensibility and loss of muscular power. It discharged urine frequently and abundantly.

Besides being used, like other stomachic stimulants, for the relief of flatulent colic and nausea, in which cases it is sometimes associated with magnesia or bicarbonate of soda, fennel is often prescribed along with laxative medicines, in order to prevent their griping, as in the officinal *tincture of rhubarb and senna.* German physicians employ it in slight catarrhal affections of the bronchia, and administer it to nursing-women to increase the secretion of milk. Boutemps has published the results of his observations and experiments, illustrating the galactagogue powers of fennel. He found that it also acts decidedly as an emmenagogue, and hence if given too freely to nursing women it may, by bringing on the menses, cause the lacteal secretion to subside.[2] Dr. A. K. Gardner states that he obtained surprising results in several cases, in one of which the secretion had been suppressed for three weeks, by employing the following formula of Hufeland: ℞.—Sem. fœniculi, gr. lx; Cort. aurant. gr. xxx; Magnes. carb. gr. clxxx; Sacch. alb. gr. cxx. —M. S.—A teaspoonful three times a day.[3]

Administration.—The preparation of fennel-seed most frequently employed is the *infusion*, made with sixty grains of the seed to half a pint of boiling water, and administered in doses of one or two teaspoonfuls to an infant, and of a wineglassful to an adult. *Fennel-water* (Aqua Fœniculi) may be prescribed in the same doses as the infusion. The *volatile oil* (Oleum Fœniculi) is sometimes employed in doses of from one to five or ten drops, on sugar, or suspended in some appropriate vehicle.

GAULTHERIA.—Gaultheria.

Description.—The leaves of *Gaultheria procumbens*, a native plant of North America, growing in sandy soils from Canada to Georgia. Various popular names have been given it, such as Winter-green, Partridge-berry, Mountain-tea, Deer-berry, Chicker-berry, etc. It is a small evergreen plant, with ovate, shining, and

[1] Ebn Baithar, ed. Sontheimer, i. 486.
[2] Archives Gén., Oct. 1863, p. 494.
[3] Am. Med. Times, ii. 19.

coriaceous leaves, and white, bell-shaped, or ovate flowers, which are succeeded by fleshy scarlet berries, containing many seeds. Every portion of the plant has a peculiar aromatic taste and smell, which have been compared to those of orange flowers, and which are associated with astringency in the leaves, and some sweetness in the fruit. The former qualities appear to depend upon a volatile oil (*Oleum Gaultheriæ*), which is the heaviest of all the essential oils, having the sp. gr. 1.173. When fresh it is colorless, but it becomes yellowish or brownish by time. It has a sweetish, but burning and aromatic taste, and the peculiar odor of the plant.

Action and Uses.—Gaultheria is stimulant, aromatic, and somewhat astringent, a combination of qualities which has led to its being compared to cinnamon. A case is quoted by Beck,[1] of a number of soldiers at Quebec, poisoned by a tea made of andromeda, gaultheria, and ledum. It produced vertigo, weakness, vomiting, cold sweats, and in one case insensibility. Dr. Gallaher records the case of a boy nine years old, who, after taking about half an ounce of the oil of gaultheria, was seized with severe vomiting, purging, epigastric pain, hot skin, frequent pulse, slow and labored respiration, dulness of hearing, and an uncontrollable desire for food. He continued very ill for several days, but in two weeks recovered his health.[2] In the dose of an ounce it is said to have several times been fatal. The leaves of gaultheria have been at times employed by the country people as a substitute for tea, and they are extensively used in domestic medicine to prepare an infusion which is given in chronic bowel complaints, and as an emmenagogue. Physicians more frequently prescribe the oil to conceal the taste of nauseous medicines. It gives a peculiar flavor to the compound syrup of sarsaparilla. It may be used for the same purposes as the essential oils already mentioned, and particularly as a carminative; but it is less grateful to the stomach than other articles of its class.

HEDEOMA.—Hedeoma.

Description.—The leaves and tops of *Hedeoma pulegioides*, American pennyroyal, an indigenous annual plant abounding in dry sterile places in all parts of the United States. It is about a foot high, much branched, with small, opposite, acutely oval or oblong lanceolate leaves, which are somewhat rough and pubescent. The flowers are axillary, very small, and of a pale blue color. The whole herb contains a volatile oil which diffuses for some distance its powerful aromatic odor, which is still very strong even in the dried state of the plant. Pennyroyal imparts its virtues to hot water, but more fully to alcohol; they depend upon the oil, which may be procured by distillation. It is of a light yellow color when recent, and has a specific gravity of 0.948.

Action and Uses.—Pennyroyal is a stimulant aromatic, and

[1] Med. Jurisp., 10th ed , ii. 885. [2] Phil. Med. Examiner, viii. 347.

may be used to relieve nausea from unwholesome food, or flatulent distension of the primæ viæ and the colic dependent upon it. It may also be employed to flavor purgative and other draughts which tend to gripe or to excite nausea. Emmenagogue virtues are properly attributed to it, and of these it possesses as much as, if not more than, other herbs of its class. In warm infusion it often succeeds in bringing on the menstrual discharge when it is delayed by temporary causes, and particularly by the operation of cold. A warm foot or hip-bath should be prescribed at the same time. In like manner, by a stimulant operation, warm pennyroyal tea is often an efficient diaphoretic remedy in the forming stage of catarrh and of muscular rheumatism. The *infusion*, made with half an ounce of the plant to a pint of water, may be given in doses of two or more fluidounces every hour. The *volatile oil* (OLEUM HEDEOMÆ) may be used internally for the same purposes as the plant, in doses of from two to ten drops; or externally as an ingredient of rubefacient liniments. It is said to have been sometimes employed for the purpose of producing abortion, but we are acquainted with no well-authenticated case of its attaining this object.

European pennyroyal (MENTHÆ PULEGIUM) is identical in action with peppermint, but as its odor and taste are not so agreeable, it is much less used. (*Neligan.*)

LAVANDULA.—LAVENDER.

Description.—*Lavandula vera*, whose flowers form the officinal medicine under consideration, is a small shrub which is a native of Southern Europe and the North of Africa, but is cultivated as a garden plant all over Europe and this country. Its main stem is woody, but terminates above in numerous herbaceous, erect, quadrangular branches, which are furnished with many linear leaves. The flowers, which are in spikes, are of a purplish-gray color, and have a powerful but refreshing aroma, and a warm, bitter, aromatic taste. These qualities depend chiefly upon an essential oil, which is obtained by distillation, and is associated with a bitter principle and with tannic acid.

History.—The name of this plant is of Italian origin, and that under which it was employed by the ancients is unknown. Matthiolus, however, describes it by the name of Nardus Italicus, and says that it is used as a remedy for epilepsy, apoplexy, spasms, and paralysis; that it is also stomachic, and strengthens the liver and spleen, and is emmenagogue and ecbolic, diuretic, and carminative. He further speaks of the peculiarly penetrating odor of its essential oil.[1] Alston repeats the same list of virtues attributed to this plant.[2]

Action and Uses.—It is asserted that lavender flowers, in large doses, occasion colicky pains and excite the circulatory system.

[1] Liv. i. chap. vi. [2] Lectures, ii. 159.

Strumpf states that a drachm of the volatile oil of lavender given to a rabbit, caused the animal to utter loud cries, and breathe hurriedly, and presently to die in convulsions, without any trace of a local action of the poison remaining in the stomach.[1]

Lavender alone is hardly ever employed as a medicine; the only use to which it is applied is for scenting clothes by scatering the spikes among them, or placing the flowers inclosed in muslin bags in the usual receptacles of clothing. The *oil of lavender* (OLEUM LAVANDULÆ) may be given internally in doses of four or five drops to allay nervous agitation or relieve nervous headache. The *spirit of lavender* (SPIRITUS LAVANDULÆ), made by distilling alcohol from the flowers, or by dissolving the oil in alcohol in the proportion of a fluidounce of the former to a gallon of the latter, is used for the same purposes occasionally, but much more frequently as a refreshing perfume in the sick-room, or as an article for the toilet. The *compound spirit of lavender* (SPIRITUS LAVANDULÆ COMPOSITUS) is an old and famous medicine of the English Pharmacopœia. It originally contained as many as thirty ingredients, but is now made by digesting cinnamon, cloves, nutmeg, and red saunders in a mixture of the spirit of lavender and spirit of rosemary. It is a popular and very efficient remedy for flatulent colic, and for gastric uneasiness, and the accompanying general depression produced by laborious digestion. It may be added to bitter tonic infusions to increase their efficacy and to correct their taste. The dose is a fluidrachm.

MELISSA.—BALM.

Description.—Balm belongs to the secondary list of the United States Pharmacopœia. It is composed of the leaves and tops of *Melissa officinalis*, a native of the South of Europe, an herb from one to two feet high, consisting of several quadrangular stems rising from a perennial fibrous root. The upper leaves are pubescent and ovate, the lower cordate. The flowers, which are grouped on short axillary peduncles, are white or yellow. Balm has a peculiar fragrance in the fresh state, which has been compared to that of lemons; but it is nearly inodorous when dry. The taste is slightly aromatic and bitterish. Its qualities depend upon an essential oil which has the peculiar smell and taste of the fresh plant in a high degree. It also contains bitter and astringent principles.

History.—Dioscorides derives the name of this plant from the fact that bees are very fond of its flowers, and make the best honey (μελ) from them. He speaks of the virtues of the bruised leaves when applied to the stings of insects, etc., of fomentations made with them to provoke the menstrual discharge, of the tea as a mouth-wash for toothache, etc.[2] The Arabians attributed wonderful virtues to this simple herb. Avicenna declared that it possesses an astonishing power of cheering and strengthening the

[1] Handbuch, i. 633.

[2] Op. cit., lib. iii. ch. c.

heart. Its perfume, and its attenuating and astringent properties, render it peculiar. They do good to all the organs, clearing the brain, and purifying the blood, and are serviceable in all atrabilious and mucous disorders. When chewed, the leaves sweeten the breath and allay thirst; they also quicken digestion, and relieve nausea and faintness. Another writer says that balm dispels drowsiness, and expels flatus from the stomach and bowels. But, as if to throw doubt upon such opinions, another Arabian author gravely assures us that among its surprising qualities is this—that if its roots, leaves, and seeds inclosed in a bag are worn about the person, they will form an amulet to secure the affections of one's friends, will make all his undertakings succeed, and render him joyous and happy so long as he wears it.[1]

Uses.—Balm tea is a popular and most refreshing drink when made from the fresh plant and taken cold; and the hot infusion of the dried plant is one of the mildest that can be used to assist the operation of diaphoretic medicines. It may be made with from half an ounce to an ounce of the herb in a pint of water.

MYRISTICA.—Nutmeg.

Macis.—*Mace.*

Description.—Nutmeg is the kernel of the fruit of *Myristica fragrans*, a native tree of the Molucca Islands, but now cultivated on the Indian continent and the adjacent islands, in the West Indies, and South America. It is a handsome tree of from twenty to thirty feet in height, with leaves bright green upon their upper surface and whitish beneath, and pale yellow flowers, of which the male and female grow upon different trees. Three crops of the fruit are said to be produced annually in the Moluccas. It is about the size of a peach, yellow when ripe, and as its fleshy part dries it divides in the middle, disclosing a thin brown shell enveloping the kernel, surrounded by a yellowish-brown and reticulated membrane (arillus), which is the officinal *mace.* The nutmeg, or kernel, is of a rounded oval shape, depressed at either end, of a grayish-brown color, and marked by irregular furrows. Internally the surface of a section is lighter in color than the outside, but is traversed by reddish veins which contain an essential oil. Owing to this oil nutmeg is not easily pulverized, but may be readily crushed or cut. Its odor is strong, aromatic, and grateful, and its taste is oily, warm, and acrid.

The constituents of nutmeg are mainly a *volatile* and a *fixed oil.* The former is obtained by distillation with water, is colorless or pale yellow, of a viscid consistence, and has the odor and taste of nutmeg. It is, however, separable into two oils, one of which is lighter and the other heavier than water. The fixed oil is pro-

[1] Ebn Baithar, ed. Sontheimer, i. 109.

cured by subjecting a paste of nutmegs to heat and pressure. It is an orange-colored soft-solid, having the peculiar odor of the volatile oil.

History.—It does not appear probable that the Greeks or Romans were acquainted with nutmegs or mace. The earliest account which we possess of them is contained in the writings of the Arabian physicians; in these reference is made to the Indian origin of the nutmeg. Avicenna states that it is useful in impaired vision and dysuria, that when mixed with oil and also in pessaries, it is anodyne, and that it stops vomiting. Rhazes says that it is good for the stomach and liver, and Isaac Ben Amrân says that it is carminative, and is useful in various spots and eruptions on the skin. In general, according to another writer, it strengthens and warms the relaxed stomach, and cures diarrhœa depending upon atony of the intestines, etc.[1] In the Molucca Islands and on the continent of India it is considered one of the most valuable medicines in dyspeptic complaints and in all cases requiring cardiacs and corroborants; it is likewise prescribed for such puny children as appear to suffer much in weaning.[2]

Action. *On Animals.*—Mitscherlich, who administered the volatile oil of nutmeg to rabbits, found that six drachms proved fatal in thirteen hours and a half. The following were the principal symptoms produced by it: Increased activity and force of the circulation, restlessness, followed by muscular weakness, bloody, strong-smelling urine, then diminished action of the heart, labored breathing, coldness, and death without convulsions.[3]

On Man.—Bontius states that nutmeg has a narcotic property, and that he had seen persons unaccustomed to its use lie immovable and speechless in consequence of having eaten too largely of it.[4] Cullen relates the case of a person who, having taken by mistake two drachms or a little more of powdered nutmeg, was seized with drowsiness, which increased to stupor and insensibility followed by delirium. These symptoms continued for six hours.[5] Purkinje took a nutmeg fasting, piecemeal and with sugar. The whole day long his senses were dull and his limbs heavy, his mind was not disturbed, but a glass of wine after breakfast affected him unusually. One afternoon, after he had taken three nutmegs, he immediately fell asleep and passed between two and three hours in a dreamy but pleasant state. At the end of this time he went out, and, although he had full command of his muscles, his dreamy, half-unconscious state continued. For several days afterwards wine excited him in an unusual degree.[6] Ainslie mentions that although mace is a favorite medicine with the Hindoo doctors, they generally administer it cautiously, from having ascertained that an overdose is apt to produce dangerous stupor and intoxication.[7] Pereira was acquainted with a case in which the narcotic

[1] Paulus Ægineta (Syd. Soc. ed.), iii. 436; Ebn Baithar, i. 269.
[2] Ainslie, Mat. Ind., i. 249.
[3] Arzneimittellehre, ii. 148.
[4] De Med. Indorum, p. 47.
[5] Mat. Med., ii. 204.
[6] Wibmer, Wirkung, etc., iii. 308.
[7] Op. cit., i. 201.

effects of a whole nutmeg had been several times experienced.[1] It does not appear to have proved fatal in any case. The volatile oil acts locally as a mild rubefacient.

Uses.—Nutmeg is very little employed as a medicine, but almost wholly as a condiment for preparations of milk and farinaceous substances. In Germany it is frequently used to promote the digestion of oleraceous plants, particularly cabbage and cauliflower. Mace is still more commonly employed to season food, and especially soups and pastry. Powdered nutmeg may be given in cases of simple debility of the stomach in the same manner as other aromatics, and in doses of from five to twenty grains. The *volatile oil* may be prescribed in the dose of two or three drops; and *spirit of nutmeg* (SPIRITUS MYRISTICÆ) in doses of one or two fluidrachms. Nutmeg and its derivatives are used chiefly for the purpose of flavoring medicines. They enter into many of the aromatic preparations. The oil, however, on account of its rubefacient action, is sometimes applied externally by friction, either alone or as an ingredient of stimulating liniments.

MENTHA PIPERITA.—PEPPERMINT.

Description.—Peppermint is the herb of *Mentha piperita*, a small perennial plant, which is largely cultivated in England and in this country. It is also found on the continent of Europe, but of inferior quality. It has an unpright and smooth stem; dark-green, smooth, opposite, petiolate, ovate-oblong, and serrate leaves; numerous purple flowers, arranged in terminal obtuse spikes, interrupted at the base. The leaves and tops are officinal. The odor of peppermint is very strong and pungent, and it has a hot and somewhat bitter taste, which is followed by a sense of coolness when the breath is drawn rapidly into the mouth. These qualities are very feeble in the dried herb, and they depend upon a *volatile oil* (OLEUM MENTHÆ PIPERITÆ) which abounds in the fresh plant, and is obtained by distillation with water. When recently prepared it is colorless, but it acquires a faint green tinge and then becomes reddish by age. Besides this oil, peppermint also contains a crystallizable stearoptene, or peppermint-camphor, and a fatty oil capable of becoming rancid.

History.—Several species of mint were used by the ancients, one of which, called Ἡδύοσμον, is generally believed to be *Mentha sativa, L.*, but *M. piperita* is supposed to be a native of England. Guibourt states that the older botanists of the continent, as Bauhin, Geoffroy, etc., make no mention of it, but that it abounds and is much used in China.[2] In that country an exceedingly strong oil of peppermint is employed as a local anodyne and rubefacient. Dioscorides and the Arabians describe at great length the virtues of many kinds of mint, but none of them are thought to be the present officinal species.

[1] Mat. Med., 3d Am. ed., ii. 415. [2] His. des Drogues Simples, ii. 426.

Action and Uses.—The action of peppermint is that of a simple carminative stimulant. An *infusion* of the fresh herb, made in the proportion of half an ounce to a pint of boiling water, may be given in doses of a wineglassful, in cases of flatulent colic; but for this purpose the *spirit of peppermint* (SPIRITUS MENTHÆ PIPERITÆ) is perferable, in doses of from five to twenty drops mixed with a wineglassful of hot water, and sweetened. This remedy for the painful affection referred to is almost universally employed in domestic practice. Infantile cases are often treated by applying the fresh bruised herb to the abdomen. A similar application is very efficient in cases of cholera morbus in children and even in the adult. The spirit of peppermint is made by dissolving a fluidounce of the oil in fifteen fluidounces of alcohol, and filtering through the powered herb.

According to M. Pidoux, the warm infusion of peppermint is remarkably efficacious in *dysmenorrhœa*, attended with chilliness, pandiculation, muscular and especially rending uterine pains. Young chlorotic females are, also, he remarks, subject to *gastralgia* and *enteralgia* after meals, which are relieved by this infusion; and it also, if taken in the interval between meals, prevents such attacks. Nervous headaches, palpitations of the heart, hiccup, etc., are often dissipated by its means. This writer recommends it as an ordinary drink in typhoid affections, in the cold stage of Asiatic cholera, and in other excessive fluxes.[1]

Peppermint water (AQUA MENTHÆ PIPERITÆ) is made by dissolving half a fluidrachm of oil of peppermint in two pints of water by the intervention of carbonate of magnesia. It contains nearly a minim of the oil in each ounce of water. It is used as a vehicle for many medicines that tend to produce nausea or to gripe, and may be prescribed in doses of three fluidounces or less. But it is much less acceptable to the stomach than spearmint water.

Peppermint lozenges (TROCHISCI MENTHÆ PIPERITÆ), made with oil of peppermint, sugar, and mucilage of tragacanth, are used to relieve flatulence and colic, and to prevent sea-sickness. This and the other preparations of peppermint are apt to excite gastric pain in persons who are well and who partake of them immoderately.

MENTHA VIRIDIS.—SPEARMINT.

Description.—Spearmint is the herb of *Mentha viridis*, an herbaceous perennial plant, a native of the milder parts of Europe, of Africa, and America, flourishing best in a moist soil. It has an erect, smooth stem, and lanceolate, subsessile, unequally serrated leaves of a light-green color. The flowers are purplish, and arranged in elongated pointed spikes. Its smell and taste are less intense than those of peppermint, and to most persons they are more agree-

[1] Thérapeutique, 5ème ed., ii. 475.

able. They depend upon a volatile oil, which is much less abundant than in peppermint.

Uses.—Spearmint is employed medicinally for the same purposes as peppermint, and exhibits the same powers in a lower degree.

The officinal preparations of this medicine are the *volatile oil* (OLEUM MENTHÆ VIRIDIS), of which the dose is from one to six drops; the *spirit of spearmint* (SPIRITUS MENTHÆ VIRIDIS), of which from ten to forty drops, properly diluted, may be given at a dose; and *spearmint water* (AQUA MENTHÆ VIRIDIS), which may be prescribed in teaspoonful or larger doses. The last-mentioned preparation is the only one much used, and chiefly as a vehicle for medicines of an unpleasant taste, or which are apt to nauseate.

MONARDA.—HORSEMINT.

Description.—Monarda consists of the leaves and tops of *Monarda punctata*, an indigenous herbaceous plant, found in light sandy soils from New Jersey to Florida. Its stems are from one to three feet high, obscurely quadrangular, whitish, and downy. The leaves are oblong-lanceolate, smooth, serrate, punctate, and tapering to a short footstalk. The flowers are yellow, spotted with brown, disposed in numerous whorls, and having lanceolate colored bracts extending beyond the whorls. The whole herb contains a volatile oil, on which its virtues depend, and it has a strong aromatic odor, and a warm, pungent, bitterish taste. The oil is of a reddish-amber color, and has an exceedingly pungent smell and taste.

Action and Uses.—Horsemint was first brought into notice as a medicine by Dr. E. A. Atlee, in 1819.[1] He states that it was popularly regarded as a diaphoretic, diuretic, and carminative, and that its volatile oil is a powerful irritant, capable even of vesicating the skin.

The warm infusion of horsemint is an excellent diaphoretic in recent and mild cases of *rheumatism* and *bronchitis*, and, like other medicines of its class, occasionally proves emmenagogue. Elliott attributes the latter quality especially to the root. The cold infusion is said to have diuretic qualities.

The essential oil, pure or diluted, with alcohol or tincture of camphor, was used by Dr. Atlee as a liniment for chronic rheumatism and various local pains, in hemiplegia and other forms of *paralysis;* and in one case of *deafness*, of several months' duration, hearing was restored by bathing the scalp with the undiluted oil. He believed it to be of great service as a stimulating embrocation in the low stage of epidemic *typhus*, and in the advanced period of *cholera infantum*, when rubbed upon the abdomen. Dr. Eberle also found the latter application serviceable in allaying gastric irritability, and arousing the powers of life.

Administration.—An *infusion* of horsemint, made with half an

[1] Am. Med. Recorder, ii. 496.

ounce of the herb and a pint of water, may be prescribed in wine-glassful doses. Of the *volatile oil* (OLEUM MONARDÆ), two or three drops may be given internally, mixed with sweetened water. As a rubefacient the oil should be diluted with from two to four parts of olive oil or of soap liniment, unless an immediate and powerful impression is required. In that case it may be applied pure.

PETROSELINUM. Vid. *Diuretics.*

PIMENTA.—PIMENTO.

Description.—Pimento is the name given to the dried unripe berries of *Eugenia Pimenta*, a tall and beautiful evergreen tree of the Island of Jamaica. Its foliage is very dense, and the leaves are about four inches long, of a deep shining green color, elliptical and veined. The flowers are numerous, small, of a greenish-white color, and are arranged in terminal panicles. The fruit is a dark purplish, two-seeded berry, crowned with a persistent calyx, smooth, shining, succulent, and containing two uniform flattened seeds. When dry, and as found in commerce, the berry is about the size of a pepper corn, brown, dull, rough, and umbilicated at the summit. The taste of pimento is very strong and agreeable, and its smell, which has some resemblance to that of cinnamon, cloves, and nutmeg together, has procured for it the popular name of *allspice.* It is also called *Jamaica pepper*, in reference to its origin.

The virtues of pimento depend chiefly upon its essential oils. Of these one is *volatile* (OLEUM PIMENTÆ), and the other *fixed.* The former is very abundant, constituting about six per cent. of the dried berries, and possesses all the active properties of oil of cloves. The fixed oil has a greenish color, a rancid odor, and an acrid burning taste.

Action and Uses.—Pimento is an aromatic stimulant, and, like other substances of its class, is used as a condiment to stimulate the digestive organs when they are suffering from exhaustion, and particularly from the debility caused by the prolonged heat of summer in tropical regions. In medical practice it is chiefly prescribed to relieve flatulence, to augment the effect of vegetable tonics, and to correct the tendency of purgatives to produce griping, or the nauseous taste of certain medicines.

PIPER.—BLACK PEPPER.

Description.—Black pepper is the dried, unripe berry of *Piper nigrum*, a perennial, climbing vine, which is a native of the East Indies, and is extensively cultivated on the Malabar coast, the Malay peninsula, in Java, Sumatra, and other islands. The berries, which are in long, tapering clusters, are round, about the size of a pea, at first green, then red, and afterwards black.

As found in commerce the unripe berry is nearly black, and shrivelled. Internally there is a white kernel, which is hard without, but farinaceous in the centre. It has the hot, biting, pungent taste with which every one is familiar. A variety, known as white pepper, is made from the ripened berry, by soaking it in water, and then removing the exterior dark pulp by friction. But in this process a portion of the active properties of the berry is lost. These depend chiefly upon a crystallizable principle called *piperin*, an acrid resin, and a volatile oil.

Piperin was discovered by Œrsted, in 1819, and regarded by him as a halogen body, and as the cause of the peculiar taste of pepper. Pelletier alleged, however, that this substance, when pure, is devoid both of taste and smell, and is related to the resins rather than the alkalies. Dr. Christison's examination of piperin agrees in its results with those of Œrsted. This substance is obtained in colorless rhombic crystals, insoluble in water, but soluble in alcohol and ether. The *acrid resin*, or concrete oil, is liquid at a little above the freezing point of water, has an exceedingly pungent and acrid taste, and is soluble in alcohol and ether. The *volatile oil* is separable by distillation with water, is colorless when fresh, and has the odor and taste of pepper in a marked degree.

History.—Pepper was very anciently used as a medicine. It is repeatedly referred to in the Hippocratic writings, and mentioned as a stimulant expectorant, as adapted to quicken labor, etc. Theophrastus describes the round and the long species, and their calefacient operation, and also states that they are antidotes to hemlock.[1] Dioscorides mentions the Indian origin of pepper, but appears to confound *Piper longum* and *P. nigrum*. The former, he says, is the stronger of the two, and adds that black pepper has more virtues than white. All sorts, he remarks, are healing, diuretic, maturative, drawing, and resolvent, remove opacities of the cornea, and, both internally and externally employed, cure chills which precede periodical fevers, are antidotes to the bites of serpents, provoke the discharge of the dead fœtus, and prevent conception if applied by the female immediately after coition as a suppository in the vagina; they are useful in coughs and pulmonary complaints, relieve colic, and, when used as condiments, excite the appetite and improve digestion.[2] Celsus mentions both long and round pepper[3] as diuretics, and recommends drinking hot water with pepper to prevent the chill of intermittent fever.[4] The use of pepper for the cure of intermittents is strongly recommended by Stephanus, in his Commentary on Galen.[5] Rhazes speaks of pepper as unsuitable for warm, but as well adapted to cold temperaments, and warns against its use those who are affected with ulcers of the bowels, with ardor urinæ, or inflammations of the liver. Other Arabian writers recommend it as an application to carious teeth, for the relief of pain; as a

[1] Hist. Plant., ix. xxii.
[2] Mat. Med., ii. cliii.
[3] Book ii. ch. xxxi.
[4] Book iii. ch. xii.
[5] Paulus Ægineta, Comment. (Syd. Soc. ed.), iii. 295.

remedy for alopecia, when the bald scalp is rubbed with a mixture containing it, along with salt and garlic; as an application in farinaceous poultices in some cutaneous eruptions, and mixed with diachylum plaster to discuss œdematous swellings, and allay flatulent distension of the bowels; with olive oil as a liniment for paralyzed and insensible parts; with astringent substances for the relief of micturition in persons of a cold phlegmatic habit, etc.[1] Ettmüller, Bartholin, Ernestus, Kunrad, and Schroder, in the last century, furnished examples of the cure of intermittent fever by this medicine.[2] In some parts of Europe, also, an infusion of pepper in brandy was a popular remedy for this disease. The native doctors of India prescribe an infusion of roasted pepper to arrest vomiting in cholera, and prepare with it a kind of liniment which they suppose to have sovereign virtues in rheumatism.[3]

Action and Uses.—Applied to the skin, powdered pepper occasions severe pain and redness; in the mouth and throat in large quantities, it excites intense burning; and in the stomach a sense of diffusive warmth, with some acceleration of the pulse. In very large doses it appears sometimes to have produced alarming symptoms. Van Swieten relates the case of a man who swallowed a large quantity of ground pepper and was seized with a severe and dangerous fever; Wendt a case in which intestinal inflammation and delirium ensued; Lange one of a person who became delirious after taking two spoonfuls of pepper in wine; Jæger the case of a man who had taken from three to four drachms of pepper in a glass of brandy, and was soon after found in convulsions; on recovering his consciousness, he complained of burning pain in the throat and stomach, was extremely thirsty, and vomited all the drink that he swallowed. In another case a young man took thirty white peppercorns in brandy. Violent burning heat in the epigastrium, thirst, and rigors ensued. On the following day a pain, compared to the heat of a live coal, was felt in the region of the duodenum. For three days these symptoms continued, with constipation and fever, and in spite of the administration of several doses of sweet oil and an enema. A dose of castor oil was then given, after which the pain shifted its seat, and gradually subsided when the pepper-corns had been discharged.[4] In treating intermittent fever with *piperin*, Chiappa observed that generally after its administration, a burning sensation in the stomach, and sometimes in the throat, was complained of, and not unfrequently heat in the rectum and the whole abdomen, in two cases the eyes became injected, and the eyelids, lips, and nose were swollen.[5]

These cases prove, what daily observation also shows, that the action of black pepper is rather that of a local than a diffusible stimulant. It stimulates the feeble digestion, and enables the

[1] Ebn Baithar, ed. Sontheimer, ii. 261.
[2] Murray, App. Med., v. 32; Alston, Mat. Med., ii. 312.
[3] Ainslie, Mater. Ind., i. 304.
[4] Wibmer, Wirkung der Arzneim., iv. 218.
[5] Dierbach, Neueste Entdeck., ii. 354.

stomach to appropriate food which, without its aid, would not be assimilated, and at the same time prevents the formation of flatus or provokes its discharge. Its local action upon the rectum led to its being anciently employed as a remedy for *hæmorrhoids*, and this practice has been imitated in modern times, first empirically in the form of *Ward's paste*, a nostrum which had great vogue in London, and subsequently by the compound confection of pepper, of which Sir B. Brodie recommends a piece the size of a nutmeg to be taken three times a day; and he states that very severe cases of piles are sometimes cured by it.[1] In some cases of fistula in ano, of gleet, and of leucorrhœa, pepper has been found very serviceable; in the second of these affections, however, it is probably inferior to cubebs.

The treatment of *intermittent fever* by black pepper has already been mentioned as an ancient method of practice, and in modern times it has been revived by the use of piperin, and of pepper itself. In 1816, Louis Frank, of Parma, after having in vain endeavored to cure a tertian ague with bark, and afterwards with opium, prescribed six pepper-corns to be taken twice a day, and afterwards increased the dose to nine. A cure was speedily effected. Afterwards he treated seventy persons affected with intermittent fever, and in the majority the disease was arrested after the second or third paroxysm. The cases of relapse were rare, more so than when bark was used.[2] In 1824, Miccoli, of Ravenna, Bertini, of Turin, Simonetti, of Pesaro, and Gordini, of Leghorn, used piperin successfully, the first in twenty-two cases, and the others in a smaller number.[3] Riedmüller, of Nuremberg, is reported to have treated five hundred cases very successfully with this remedy.[4] Dr. Hartle, of Trinidad, states that in the intermittents of that island he found piperin to eradicate the disease when quinia failed;[5] and Dr. Blom considered this substance particularly applicable in cases which resist quinia, or which frequently relapse in spite of the use of that medicine.[6] The preceding summary of the principal reports which have been published concerning the use of this medicine for the cure of intermittent fever leaves no doubt of its efficacy, and shows that it is not to be overlooked in the list of antiperiodic remedies. Probably its real value consists in its stimulant operation, and in that it is particularly applicable, on the one hand, to very mild cases of the disease, and on the other, to those chronic forms which are often prolonged by want of tone in the system generally, and by debility of the digestive organs in particular. In such cases, as appears in the history of many tonic and stimulant medicines, any strong excitant is occasionally adequate to the cure. Under circumstances like those referred to, the association of black pepper with quinia or bark is probably more efficacious than the administration of either medicine alone.

[1] Lectures (Am. ed.), p. 312.
[2] Journ. Complement., viii. 371.
[3] Revue Méd., xiv. 294; xix. 313.
[4] Trousseau and Pidoux, op. cit., 5ème éd., ii. 502.
[5] Edinb. Med. and Surg. Journ., Jan. 1841.
[6] Dierbach, op. cit., ii. 331.

Administration.—*Powdered pepper* may be given as a stomachic stimulant in doses of from five to twenty grains or as a condiment freely mixed with the food. As an antiperiodic, eight or ten grains of *whole pepper* may be prescribed two or three times a day. The ethereal *fluid extract* (OLEORESINA PIPERIS), or oleoresin *of black pepper*, may be directed as a stimulant in doses of one or two minims properly guarded in emulsion or pill. *Piperin* may be given in doses of from one to ten grains.

ROSMARINUS.—ROSEMARY.

Description.—*Rosmarinus officinalis*, the plant whose leaves constitute this medicine, is a native of Europe near the shores of the Mediterranean, but it is cultivated in other European countries and in the United States. It is a small evergreen shrub with numerous erect branches, and opposite, sessile, linear leaves, smooth and green upon the upper surface, and white and downy beneath. The flowers, of a pale-blue color, are gathered into small clusters in the axillæ of the upper leaves. The flowering tops have a strong and peculiar odor due to a volatile oil. They are eagerly sought as food for bees, and it is to them that the honey of Narbonne owes the flavor for which it is so justly famous.

The volatile oil is yielded by distillation of the fresh tops in the proportion of from one-fourth of one to one per cent. It is a transparent white or amber-colored liquid, and sometimes even greenish, with the characteristic odor of rosemary, and an acrid, aromatic, and burning taste. On exposure to the air it deposits a large quantity of stearoptene.

History.—Rosemary was very anciently known and employed in medicine. Theophrastus describes the stimulating properties of its herb and root, and ascribes to it emmenagogue, diuretic, and galactagogue virtues.[1] To this account Dioscorides subjoins that it is discutient, is good for hæmorrhoids and other diseases of the anus, and relieves colic.[2] An Arabian writer, besides mentioning the virtues here attributed to the plant, states that it is carminative, removes obstructions of the liver and spleen, is also expectorant, and useful in cases of asphyxia, of dyspnœa, and dropsy.[3] Murray styles it one of the most potent aromatics of its class, in stimulating and sustaining the nervous system, and in dissipating and resolving swellings and indurations. He speaks of its remarkable power as a diaphoretic, emmenagogue, and carminative; says that it is justly esteemed in nervous disorders, such as loss of memory, vertigo, and paralysis; adds that it is regarded as efficacious in humid asthma, and in strumous enlargement of the cervical glands.[4] A distilled spirit in which rosemary is associated with lavender flowers, or with sage and ginger, has become famous under

[1] De Nat. Plant., lib. ix. cap. xii.
[2] Op. cit., lib. iii. cap. lxxii.
[3] EBN BAITHAR, ed. Sontheimer, i. 73.
[4] App. Med., ii. 206.

the name of *Aqua Hungarica*. It is a delightful perfume, and has marvellous virtues attributed to it by the credulous.

Action and Uses.—According to Strumpf, the oil of rosemary is an active poison, even more so than oil of savine or of mustard. In the dose of a scruple it destroyed a rabbit after occasional spasms.[1] A case of death is recorded in a child three or four years old, from a mixture of six measures of this oil, and two of oil of wormseed given in repeated doses of a tablespoonful.[2]

Rosemary is used medicinally to relieve *colic*, to promote *menstruation*, and to allay slight *nervous derangement*, depending upon debility. The oil is employed as an ingredient of ointments and liniments intended to be applied by friction to *rheumatic or paralyzed muscles*, to swellings left by inflammation, or produced by chronic scrofulous enlargement of the glands, to bruises, sprains, etc., and to the scalp to promote the growth of the hair. The vapor of the oil produced by rubbing a few drops between the palms of the hands and then allowed to come in contact with the eyes, has been used with advantage in weakness of these organs from nervous exhaustion.

Administration.—An *infusion* of rosemary, prepared with from 120 to 240 grains of the plant to half a pint of water, may be prescribed in tablespoonful doses. The volatile *oil* (Oleum Rosmarini) may be given in doses of from two to four drops. This preparation is seldom used internally or alone, but enters into the composition of various stimulant liniments and tinctures.

RUTA.—Rue.

Description.—The leaves of *Ruta graveolens*, a native of Southern Europe, but cultivated in England and the United States. Rue is a perennial plant, two or three feet high, much branched, woody, on the main stem covered with a rough bark, but smooth and green upon the smaller branches. The leaves are fleshy, doubly pinnated, smooth, glaucous, and slightly tomentose. The flowers are of a pale greenish-yellow, in terminal corymbose panicles, and are succeeded by four-lobed gibbous capsules, containing numerous blackish angular seeds.

The plant exhales a strong aromatic but disagreeable odor, and has a bitter, hot, and acrid taste. Its active properties depend mainly upon a volatile oil of a greenish-yellow color, of a very offensive odor, and acrid and bitter taste, which abounds in small glandular bodies covering the whole surface of the plant. By drying a great part of its activity is lost.

History.—Hardly any medicine was more frequently employed or with greater confidence in its virtues than this now neglected plant. We think the reader will find, in the summary which fol-

[1] Handbuch, i. 636.
[2] U. S. Dispensatory, and Am. Journ. of Pharm., xxiii. 286.

lows of medical opinions concerning its value, that it is at the present day too much disused.[1]

It was among the medicines frequently recommended by Hippocrates. He says that it is rather diuretic and laxative, and, indeed, is somewhat astringent, and is good to take as a preservative against poisonous substances.[2] But it was chiefly used by him in uterine affections; when taken with wine, to promote the lochial discharge; with astringents, to moderate plethoric menorrhagia; with aromatic stimulants, in amenorrhœa, etc.[3] Dioscorides dwells at length upon its virtues; says that it is caustic, calefacient, ulcerative, diuretic, emmenagogue, and astringent to the bowels. It restricts the secretion of semen, and with anise relieves colic; it allays pain in the chest, dyspnœa, cough, gout, and sciatica, and cures intermittent fever. Clysters of oil in which it has been boiled are useful in flatulent colic. It is also anthelmintic, and eaten raw or applied in an ointment, improves the sight; the bruised plant laid on the forehead arrests epistaxis; with pepper, wine, and nitre, or with alum and honey, it cures various cutaneous eruptions and warts; and eaten after garlic or onions, it prevents their tainting the breath. This author describes the wild and the cultivated varieties of rue, and dwells upon the acrid character of the former, saying that it has proved fatal when eaten in too large a quantity, and that those who gather it when in bloom are apt to have their hands inflamed, and pustulated by its contact, to prevent which the hands and face should be anointed before the plant is touched. Wild rue, he adds, is useful in epilepsy and sciatica, excites the menstrual flow, and destroys the fœtus in utero.[4]

Pliny, besides furnishing in detail the accounts given by his predecessors, and insisting upon the poisonous qualities of the wild plant, states that the juice of hemlock (*cicuta*) protects the hands of those who gather rue, from inflammation, and that the juice of the latter, taken with wine internally, is an antidote to aconite, mistletoe, mushrooms, the bites of serpents and insects, etc. He also remarks that if, as Hippocrates supposed, rue is diuretic, it is singular that it should be used by some to moderate incontinence of urine.[5] Galen states, that when mixed with food it extinguishes the generative power by drying up the secretion of semen, and also that when strewed in the beds of those who are disposed to erotic dreams and priapism, it lessens the venereal excitement. Avicenna asserts that the seeds of rue increase the appetite, strengthen the digestion, and are useful in enlargement of the spleen. Rhazes says that it prevents flatulence from vegetable food, and relieves colic, but it is not good for persons subject to headache. Elgâfaki attributes the last effect and dimness of vision to excessive use of the

[1] The Greek name of rue was πήγανον, from a verb signifying to constringe or coagulate, "quod siccitate et caliditate sua coagulet et condenset semen." It was also called ῥύδιμον "quod libidinosos nimiumque veneri addictos frenet." (Bodœus, Theophrast. Comm., p. 797.)

[2] Du Régime, Littré's ed., vi. 559.

[3] Ibid., viii. 105, 157, 245, 295, 419.

[4] Mat. Med., iii. xiv.

[5] Hist. Nat., xx. li.

plant, and alleges that in moderation it improves the eyesight. Another Arabian author states that the juice of rue rubbed upon the bald scalp will make the hair grow.[1]

The school of Salernum thus concisely enumerates the qualities of the plant:—

> "Nobilis est ruta, quia lumina reddit acuta;
> Auxilio rutæ, vir lippe, videbis acute;
> Cruda comista recens, oculos caligine purgat.
> Ruta viris minuit Venerem, muleribus addit.
> Ruta facit castum, dat lumen, et ingerit astum.
> Cocta et facit ruta de pulicibus loca tuta."[2]
>
> *Schola Salernitana*, xxxvii. 427.

Murray, in referring to the many virtues attributed to this plant by the ancients, suggests that the accounts of them require confirmation, yet he admits the strangest of them all, its power of curing epilepsy, to be well vouched for, and he claims for it a high value as an antihysteric medicine, particularly when there is at the same time suppression of the menses. Plenck attributes to a vinous infusion of rue, applied as an injection, the cure of a caries of the nostrils and alveolar process of the upper jaw; and Rosenstein, who saw the vapor of the plant cure a dimness of vision caused by excessive study, confirms the ancient statement given above.[3]

Action.—It is remarkable that in several experiments performed by Orfila upon *dogs*, in which the juice of the plant or its watery extract was introduced into the stomach, the animals perished without any decided symptoms, and the organs after death presented no local lesions capable of explaining the result. When the essential oil was injected into the jugular vein of a dog, symptoms of intoxication appeared, but they were only of a few hours' duration.[4]

Upon *man* rue acts *locally* as an irritant. This fact was well known to the ancients, as the citation from Dioscorides already given proves. The following is a case reported by Buchner. In June, 1823, after several very hot days, an apothecary named Roth gathered a quantity of garden rue, in full bloom, and stripped the leaves of it from the stalks. On the following morning he observed a considerable redness and heat of both hands, and the next day they had the appearance of having been exposed to the steam of hot water. They were then anointed with oil, but against the evening they were covered with vesicles, especially at the ends of the fingers which had been most in contact with the plant. On the fourth day the hands were still swollen, and between the blisters the skin was of a purplish hue. On the fifth and sixth days the swelling extended up the back part of the arms as far as the elbows.

[1] Ebn Baithar, ed. cit., ii. 6.

[2] So Macer Floridus celebrates the virtues of rue:—

> "Utilis est valde stomacho si sæpe bibatur.
> Expellit partus potu, veneremque coercit.
> Tussim si bibatur compescit, menstrua purgat," etc.
>
> *De Viribus Herbarum.*

[3] Apparat. Medicam., iii. 112.

[4] Toxicologie, 5ème éd., ii. 579.

Fomentations of chamomile and elder-flowers were applied, and the blisters cut. In the course of four weeks the entire cuticle exfoliated by degrees, even where there had been no blisters. His children, who had played with the rue, suffered from swelling of the face and hands.[1] A precisely similar case, in which three persons suffered the irritating effects of the plant, was reported in 1862 by M. Soubeiran.[2]

The effects of large doses of rue, taken *internally*, are described by M. Hélie in an article published in 1838,[3] and this contains, so far as we know, the only account of the subject, except the case of a man convalescent from dysentery, who died with symptoms of intestinal inflammation after drinking some brandy mixed with the expressed juice of the herb.[4] M. Hélie relates three cases of attempts to produce abortion by this plant, in one of which a decoction of the fresh sliced root, in the second a decoction of the leaves, and in the third the expressed juice of the leaves was taken. The effects were in one case, violent pain in the stomach, and vomiting, or rather efforts at vomiting, with the rejection of a small quantity of blood. In all of the cases the nervous system was prominently deranged; there was great prostration, with confusion of the mind, cloudiness of vision, feebleness of the pulse, coldness of the extremities, and twitching of the limbs. All of the females who were in the fourth or fifth month of pregnancy aborted and recovered. Dr. Christison remarks, concerning the narrative which has here been briefly given, that it may be suspected that M. Hélie overrated both the poisonous properties of the drug and its ability to induce miscarriage.[5] But, presuming the account, however imperfect, to be accurate, we are obliged to recognize in it a proof of the general sedative and locally irritant action of the medicine in large doses, and of its specific operation upon the uterus. The following statement is made by Dr. Van de Warker:[6] "A woman informed me that she used an infusion of the dried leaves, about two ounces to the quart of water, of which she took a teacupful night and morning. It always produced an abortion. She had employed it for this purpose several times. The symptoms were pain in the back, bearing down, frequent micturition continuing for several days, and oftentimes attended with headache, when there would be a 'show,' with colicky pains and abortion, which would follow in a week or ten days from the beginning of the dosing." The same writer states that in an experiment made by him in which three doses of the *oil* of rue, of ten minims each, were taken within an hour, the following symptoms were observed: uneasiness in the stomach, oppression and confusion of the brain, aching in the loins, an urgent desire to urinate, a strong smell of rue in the urine, flushes of heat, unsteadiness of gait, a tendency

[1] Wibmer, Wirkung, etc., iv. 427. [2] Bull. de Thérap., lxi. 420.
[3] Ibid., xv. 75.
[4] G. F. Cooper, Med. Examiner, N. S., ix. 720.
[5] On Poisons, Am. ed., p. 682.
[6] The Detection of Criminal Abortion (1872), p. 81.

to sleep, increased frequency and diminished tension of the pulse. When an infusion of the dried leaves was employed, the pulse fell from 80 to 69 in three hours. Supposing these observations to be accurate, the difference between the condition of the pulse in the two cases may be referred to the more intense and rapid action of the oil and the milder and slower operation of the infusion.

Uses.—There can be little doubt that rue is an efficient *antispasmodic*. Ancient authorities attest it, and among the modern even Cullen had "no doubt in asserting its antispasmodic powers." Haller also compared it to assafœtida, and administered enemata containing it to hysterical women. In *flatulent colic* the infusion of the herb, or, still better, a solution of the essential oil, answers the same purpose as peppermint and the stronger carminatives. In *amenorrhœa*, independently of plethora or inflammation, this substance becomes a powerful emmenagogue. It not only, like ergot, acts upon the gravid uterus, but it stimulates the unimpregnated organ also. Alibert particularly recommended it in *dysmenorrhœa*, and it is probable that, owing to its influence upon the nervous system, it is best adapted to those cases which are attended with hysterical symptoms. In Chili it is said to be applied to the umbilicus and to the soles of the feet to produce an emmenagogue effect. M. Beau has called particular attention to the value of this medicine associated with savin (one grain of each) in *uterine hemorrhage* after abortion, and in *menorrhagia* depending upon general debility.[1] It has also been prescribed as a *vermifuge*.

Administration.—The great loss of power which this plant undergoes in the drying process renders the fresh herb or the oil preferable for obtaining its medicinal effects. The latter, therefore, is the only available preparation which the apothecary can usually supply. It may be prescribed in doses of from one to five drops, suspended in mucilage and some aromatic liquid, and repeated at intervals of three or four hours until some of its specific effects are manifested.

SALVIA.—Sage.

Description.—Sage (Lat. salvia, from *salvare*) consists of the leaves of *Salvia officinalis*, a perennial plant which is a native of Southern Europe, but is cultivated as a kitchen herb in our gardens. It is about two feet high, has a hollow, quadrangular, pubescent stem, and ovate-lanceolate, wrinkled leaves, of a grayish-green color, sometimes tinged with red or purple. The flowers are bluish, and arranged in scanty whorls which form a terminal spike. These and the leaves have a strong and agreeable odor, and an aromatic, bitter, and somewhat astringent taste, which are due to a volatile oil. This oil, which is very abundant in the fresh herb, contains a large

[1] Annuaire de Thérap., xix. 47.

proportion of camphor. The plant also yields bitter extractive and tannin.

History.—The ancient reputation of sage is proved by the well-known lines of the school of Salernum—

> "Cur moriatur homo, cui salvia crescit in hortis;"

and

> "Salvia salvatrix naturæ conciliatrix;"

or by the still earlier verses of Macer Floridus,[1] in which it is said—

> "Cum mulsa jecoris prodest potata querelis,
> Pellit abortivum, lotiumque et menstrua purgat . . .
> Crudis vulneribus (quæ multo sanguine manant)
> Apponas tritam, dicunt retinere cruorem . . . .
> Pruritus vulvæ curat virgæque virilis,
> Si foveas vino fuerit quo Salvia cocta.
> Illius succo crines nigrescere dicunt,
> Si sint hoc uncti crebro sub sole calenti."

Equally precious qualities had been attributed to sage for more than a thousand years before. In the Hippocratic writings it is called desiccant and astringent; it was prescribed for chronic pulmonary complaints in powder and infusion; for dysmenorrhœa and amenorrhœa, it was directed with or without wine, and also to promote (?) the secretion of milk. Externally it was used in cataplasms and fomentations, and as a pessary in affections of the womb, or with wine to heal wounds and sores.[2] The account given by Dioscorides is a short one, and is paraphrased in the verses by Macer Floridus, quoted above. The plant described by Pliny is evidently not sage, although the virtues attributed to it are the same as mentioned by preceding writers. Matthiolus quotes several ancient authorities which show how generally a belief was entertained in the emmenagogue properties of this herb, of its power to promote conception, and its usefulness in hæmoptysis.[3] Floyer pronounces it cephalic, diuretic, and diaphoretic, and says that it is cleansing in gargles, and in baths and ointments discutient.[4] In 1698, Hunauld, at Paris, and Stenzel, in Germany, undertook to show that sage might be profitably substituted for Chinese tea, as a drink,[5] and it was even affirmed that the Chinese and Japanese preferred it.

Action and Uses.—Sage is stimulant, tonic, and astringent. M. Pidoux states that the infusion of half an ounce of the leaves which he took, cold, in the month of July, produced a copious sweat of several hours' duration, with insufferable flushes of heat, a slightly quickened and fuller and more active pulse, restlessness, which made study difficult, thirst, dryness of the mouth, an unusual state of constipation, a rapid increase of the appetite, and some degree of wakefulness.[6]

In regard to its curative virtues, Murray, who claims to be equally

[1] De Viribus Herbarum, ed. Vossii, 1832, p. 64.
[2] DIERBACH, Die Arzneimittel. des Hippokrates, p. 164.
[3] Commentaries, p. 273.
[4] Touchstone of Medicines (1687), p. 258.
[5] MURRAY, App. Med., ii. 199.
[6] Thérapeutique, 5ème éd., ii. 482.

removed from scepticism and credulity in regard to the plant, admits it to be, like other aromatics, a nervine stimulant, a tonic and astringent, and adapted to dissipate and purify stagnant humors. One of its most valuable operations, undoubtedly, is that of checking profuse *perspiration* when it arises from debility, particularly, as Van Swieten observes, in the decline of protracted fevers. For this symptom Sydenham prescribed Malaga wine, but Van Swieten directed an infusion of sage in wine, and gave a wineglassful of it night and morning, or used brandy instead of wine, and in that case a smaller dose. He seldom or never found it to fail.[1] According to the same authority, this treatment is injurious in phthisis, for although it arrests the sweats, the heat and harshness of the skin are increased. Fr. Dubois says, however, and in this we are disposed to agree with him, that sage tea, taken cold, will often moderate the sweats of the last stage of phthisis. He adds that by its means he suspended sweats which came on nightly for ten months, in the case of an old man who was otherwise healthy, and in that of a female under like circumstances.[2] In the case of a man, twenty-five years of age, who had long suffered from attacks of hyperidrosis so profuse that the bedclothes were saturated and the mattress also, M. Vignard succeeded in controlling the discharge by the use of a strong infusion of sage; but when the medicine was suspended the sweating returned.[3] Sage appears also to exercise some control over the secretion of *milk*, for Van Swieten found that, when, after the child had been weaned, and a troublesome dropping continued, the nurse growing leaner every day, and when he had tried various remedies in vain, the disorder ceased on his giving, every three hours, one, two, or three ounces of a strong infusion of sage.[4] These results are confirmed, to some extent, by Dr. A. K. Gardner.[5]

An infusion of sage as a mouth-wash for the cure of *aphthæ* affecting the buccal mucous membrane has long been in popular use;[6] it is applied with honey, and either with or without the addition of red wine.[7] The internal use of the infusion at the same time is of essential service in obstinate cases. It has also a very beneficial influence, when used as a gargle, in the treatment of *sore-throat*, especially of the ulcerative form, and also when the mucous membrane of the part remains loose and flabby after inflammation. It may be sweetened with honey if a merely detergent effect is required, or, if an astringent or stimulant operation is sought, it may be mixed with red wine or with alum, or acidulated with vinegar or aromatic sulphuric acid. M. Pidoux found a simple decoction of sage, or a vinous decoction, with honey, a very efficient means of promoting the cicatrization of *indolent ulcers* of the legs, when applied to them by means of compresses. Sage is also one of the

[1] Commentaries (Edinb. 1776), vi. 289.
[2] Mat. Med. Indigéne, p. 140.
[3] Edinb. Journ., xii. 665.
[4] Op. cit., xiv. 234.
[5] Am. Med. Times, ii. 19.
[6] Wedel in Murray, App. Med., i 202.
[7] Rosenstein, Mal. des Enfans, p. 47.

ingredients of the *vin aromatique* of the French Codex. It has been used in warm baths as a means of giving tone to the skin and to the system generally, and as a wash to be applied in *intertrigo*. The most common use of sage is culinary. It forms a principal ingredient of the seasoning used for gross and fatty meats, such as pork and goose.

Administration.—An infusion of sage (INFUSUM SALVIÆ), made by macerating half an ounce of the leaves in a pint of boiling water for half an hour, may be prescribed in doses of two fluid-ounces. If it is intended as a drink in fevers or to allay nausea, the fresh herb is preferable, or an infusion of the dry herb without maceration. As a *gargle*, an infusion containing from one to two ounces to the pint may be directed, with the addition of honey, alum, vinegar, or muriatic acid.

SAMBUCUS.—ELDER.

Description.—The flowers of *Sambucus Canadensis*. In Europe *S. nigra* is the officinal plant, but the qualities of the two agree. American elder "grows in all parts of the United States, and is a shrub from six to ten feet high, with a branching stem, which is covered with a rough gray bark, and contains a large spongy pith." The leaves are opposite, pinnate, or sometimes bipinnate, composed of opposite pairs of deep green leaflets. The flowers have a sweetish, but heavy smell, are minute, and arranged in large cream-colored or white corymbs, and are succeeded by small globular berries which are purplish-black when ripe. Elder flowers yield by distillation a small quantity of essential oil, and of ammonia, and contain, besides, tannic acid, an acrid resin, and various minor constituents. The juice of the ripe fruit, which has a sweetish taste, contains malic and citric acids, sugar, etc. The inner bark possesses more active properties than the flowers. In taste it is at first sweet, but afterwards astringent, acrid, and nauseous.

History.—The ancients made use chiefly of the root, leaves, and bark of the elder, as purgatives and diuretics, and of the flowers as emollient and anodyne applications. Sir John Floyer says "the bark and seeds are great water purgers in the dropsy and gout. The juice of the root makes a good purging syrup; the leaves are used in diet-drink for the dropsy; and outwardly in fomentations and ointments for tumors, scalds, burns, gout, and ulcers."

Action and Uses.—*Elder-berries* are cooling, aperient, and diuretic, and when fermented, form an agreeable wine much used in England as a domestic cordial.

The *flowers* are stated to be poisonous to peacocks, and the berries to hens. A warm infusion of them is an excellent diaphoretic. Large doses of the *fresh* flowers are said to produce nausea and diarrhœa. Water distilled from them (elder-flower water) is used as a perfume; and they are boiled with lard to prepare an ointment much employed in Europe as a pleasant application to burns and

excoriated surfaces. Elder flowers saturated with hot water are very often applied, either alone or with chamomile flowers, to parts affected with rheumatism, abscess, inflammatory swelling, or other local cause of pain. The young *leaf buds* are said to be a drastic cathartic. The *inner bark*, it has already been stated, was formerly employed for this operation. More recently Sydenham, Boerhaave, Gaubins, and Desbois de Rochefort, used it advantageously in many cases of dropsy. In 1831, Martin Solon published an account of five cases of acites in which the juice of the elder-root effected a cure after the failure, in some of them, of other remedies. He prescribed it in doses of one or two ounces taken fasting. Soon after taking it a copious discharge of saliva and mucus from the mouth occurs, and within an hour a sense of fulness at the epigastrium is followed by vomiting without excessive straining. In the course of two hours a call to stool is announced by colic, and the dejections are serous, thin, pale, or a little tinged with bile. They continue for eight or ten hours, and the following day the stomach is not disordered, but, on the contrary, the appetite is increased. After repeated doses of the medicine, the secretion of urine is augmented.[1] Other cases have been treated with equal success according to this method, by Hospital,[2] Bonnet,[3] Bergé,[4] Mallet,[5] Reveillé-Parise,[6] and Faivre.[7] Dr. McMitt, of Missouri, has published several cases of dropsy with albuminuria in which a cure seems to have been due to the use of elder-bark infused in hard cider.[8] It certainly deserves to be resorted to more frequently than it has been.

Administration.—The *expressed juice* of the fresh root is probably the most reliable of the medicines derived from elder; it may be given in doses of a wineglassful every two hours, or until its specific effects appear. A *decoction* of the inner bark may be prepared by boiling an ounce of it in two pints of water to a pint. Four fluidounces may be given at a dose.

ZINGIBER.—Ginger.

Description.—Ginger is the rhizome of *Zingiber officinale*, a native plant of China and India, and cultivated in Africa, South America, and the West Indies. It has an annual articulated stem two or three feet in height, inclosed in an imbricated sheath; long, narrow, lanceolate leaves; and a separate flower-stalk, terminating in an oval imbricated spike, between the scales of which one or two yellowish flowers appear. The root (rhizome) is tuberous, creeping, and articulated. In it the virtues of the plant reside.

As found in commerce, the dried root is covered with a coarse blackish and wrinkled epidermis, but is whitish and farinaceous

[1] Bull. de Thérap., ii. 161.
[2] Ibid., iv. 159.
[3] Ibid., v. 190.
[4] Ibid., vii. 99.
[5] Ibid., viii. 369.
[6] Ibid., x. 116.
[7] Ibid., xxiv. 231.
[8] Am. Journ. of Med. Sci., July, 1869, p. 47.

within, or is altogether of a light color in consequence of the epidermis having been removed. The former variety is chiefly derived from the East and the latter from the West Indies, and particularly from Jamaica. When powdered it is of a light yellowish-brown color.

The odor of ginger is aromatic and pungent, and its taste is hot, biting, and aromatic. It yields its active properties to water, but more completely to alcohol. They depend upon an essential oil, and upon a soft acrid resin extracted by means of ether.

History.—It does not appear that ginger is mentioned by any writer earlier than Dioscorides. He states that it is a peculiar Arabian plant, that the roots taste like pepper, and are sold in jars as a preserve. He adds that it is good to eat, and to use as a condiment; that it is warm and quickens digestion, is stomachic and slightly laxative; that it removes everything that obscures the sight; and, finally, that it resembles pepper in its action.[1] Paulus Ægineta mentions ginger-root as powerfully heating. Mesue, the younger, says that when preserved it improves the digestion, expels flatus, and hastens the assimilation of the food.[2] According to the Arabian writers it is also aphrodisiac, assists the digestion of melons and similar fruits, renders the action of purgative medicines milder, and a warm infusion of it prevents the effects of exposure to cold.[3] The native doctors of India regard it as a valuable carminative and stimulant; they also recommend it as an external application, mixed with arrack, in paralytic and rheumatic affections, and employ it as an ingredient of the decoctions used for arresting the progress of intermittent fevers.[4] Piso gives a very correct although a brief account of the virtues of ginger, saying that it is a most excellent remedy for colicky pains, for protracted diarrhœa arising from cold, for flatulence, and for intestinal tormina; but he adds that persons of an ardent temperament should use it sparingly, whether in sickness or in health, because it heats the blood.[5]

Action and Uses.—Ginger is a carminative stimulant, exciting a sense of warmth in the stomach, and increasing its activity momentarily, but afterwards leaving it feeble. Its primary action is also to quicken the circulation, diffusing a genial warmth over the whole body, and, according to some, rendering the cerebral functions more active. When powdered ginger is applied in a moist state to the skin, it occasions redness, with a sensation of intense heat and tingling. Snuffed into the nostrils, it acts as a powerful sternutatory; and when the rhizome is chewed, it occasions a copious secretion of saliva.

Ginger is most frequently employed as a *stomachic stimulant* in torpid states of the stomach with general debility of the system, but in such cases it is more advantageous when associated with

[1] Mat. Med., ii. cliv.
[2] Opera, Apud Juntas (1581), p. 132.
[3] Ebn Baithar, ed. Sontheimer, i. 537.
[4] Ainslie, Mat. Ind., i. 152.
[5] Mantissa Aromatica (1658), p. 189.

stimulant tonics whose influence is less evanescent than its own; or, when an anæmic state of the system is also present, powdered ginger with precipitated carbonate of iron or with metallic iron may be given. It is also prescribed in connection with purgatives administered to persons of a feeble constitution, who are subject to colic, or who are of a gouty diathesis. As a carminative and anodyne in *flatulent colic* no remedy is superior to a hot infusion of ginger, and this preparation, or the tincture, is an excellent medicine during the hot summer season, when there is a strong tendency to diarrhœa. During the prevalence of Asiatic *cholera* this susceptibility of the digestive organs is often successfully corrected by the occasional use of a few drops of tincture of ginger in hot sweetened water. But care should be taken not to resort habitually to this expedient, for of all the stimulants of its class none exhausts the susceptibility of the stomach more rapidly. It is then apt to impair the appetite and digestion, and induce a dry or pasty condition of the mouth, with general languor. The infusion has been sometimes used with benefit in cases of *bronchial catarrh*, such as aged persons are subject to.

As a rubefacient, ginger is a most useful application. It is one of the ingredients of the aromatic powder so frequently used with hot whisky or alcohol as an anodyne application to the abdomen in cases of *colic*. Alone, or with other substances of the same class, it is also applied to the face for the relief of *toothache*, to the temples or forehead for *headache*, etc. Its infusion is often resorted to as a gargle to correct *relaxation of the uvula;* and the rhizome may be used as a masticatory to stimulate the tongue and adjacent parts when they are affected with *paralysis*. This use of ginger, or that of the gargle, is often serviceable in cases of *aphonia* proceeding from relaxation of the vocal apparatus.

Administration.—The dose of *powdered* ginger is from ten to thirty grains; of the *infusion* (INFUSUM ZINGIBERIS), made with half an ounce of the bruised or powdered root to a pint of boiling water, one or two fluidounces; of the *tincture* (TINCTURA ZINGIBERIS) from forty minims to a fluidrachm, and of the *fluid extract* (EXTRACTUM ZINGIBERIS FLUIDUM) from ten to fifteen minims. The *syrup* (SYRUPUS ZINGIBERIS) is convenient as an addition to mixtures, or as a vehicle for powders, whose taste is disagreeable, or which, otherwise, might offend the stomach. It forms an excellent means of administering magnesia and alkaline preparations. In many cases of nausea and vomiting for which gastric stimulants are appropriate, artificial carbonated water, flavored with ginger syrup, proves useful in settling the stomach.

Several other agents might be added to the list of aromatic and stimulant tonics. Of these *tea* and *coffee* are the most important; and were it not that their dietetic so completely supersedes their medicinal use, it would be profitable to discuss their virtues, which far exceed those of numerous agents which enjoy the dignity of an officinal rank. Of *Paullinia*, or *Paraguay tea*, it is sufficient to re-

mark that its properties are closely analogous to those of tea and coffee, which is due, doubtless, to the fact that, like them, it contains caffeine. According to Mantegazza, it stimulates the intellectual centres of the brain more powerfully than either maté, coffee, or tea. It has been, like its congeners, found useful as a remedy for nervous headache, and like tea in some cases of diarrhœa. *Sarracenia*, the *Side-saddle Plant*, is an indigenous plant possessing stimulant and tonic virtues for which it enjoys a high reputation in South Carolina, where it is used in the treatment of dyspepsia and its associated ailments. A hasty and immature observation at one time ascribed to it specific virtues in the treatment of small-pox, a notion which it is almost superfluous to say was not confirmed by experience, but which, like other errors, it required some time and labor to destroy.[1]

[1] Compare Reports of Mr. Marson, Lancet, July, 1863, p. 6; and of Committee of New York Co. Med. Society, in Amer. Med. Times, viii. 7.

Class V.

GENERAL STIMULANTS.

General Stimulants are agents, the primary action of which is temporarily to increase the vital activity of the whole system. Vital activity is recognized chiefly in phenomena which the circulation and the nervous organs present, and by the degree of their vigor, under the operation of general stimulants, we estimate the power of these medicines. Under their influence the heart and arteries pulsate more strongly, the capillaries become distended with red blood, the animal temperature is raised, and all the functions, but those of the nervous system in particular, are rendered more active. Such stimulants may with propriety be denominated general, in contradistinction to such as excite particular organs or apparatus. They are also general, in opposition to those whose specific operation is confined almost altogether to the nervous system, whether to its cerebral portion chiefly, as in the case of narcotics, or to the spinal axis as in the case of spinal stimulants, or whether it affect both of these systems in various degrees in the manner of antispasmodics.

The only articles which have an indisputable right to be included in the present class are heat, electricity, alcohol, and wine. No doubt can be entertained regarding the propriety of the title of general stimulants applied to the latter two articles, but it may be considered that the first two would be more correctly placed in the class of Irritants.

Heat and electricity applied in a concentrated form are unquestionably irritants; but, as it elsewhere is stated in regard to the moxa, there is a specific impression produced by them beyond that which depends upon irritation of the skin. The frequent association of moisture and heat in the therapeutic applications of the former, both locally in fomentations, and generally in the form of baths, produces a stimulant effect which cannot be represented by the action of any mere irritant upon the skin. To these examples may be added the union of light and heat, in the treatment of certain chronic diseases by insolation, the operation of which is altogether peculiar, and independent of any degree of irritation, unless a perfectly normal stimulation may be so called. Still more peculiar is the operation of electricity. A local irritant when concentrated,

a special excitant of some of the spinal nerves in certain forms of its application, it is, nevertheless, a powerful general stimulant, and probably as essential an element of vital activity as light and heat.

In regard to the remaining medicines to which, less from conviction than in compliance with custom, we have assigned a place in this class, viz., oil of turpentine, carbonate of ammonia, arnica, and poison oak, their claims to the position are very questionable indeed. The general stimulant operation of the first two, especially, is extremely transient, and is speedily replaced by local irritation, in the bowels and urinary passages in the case of the one, and by grave and important alterations of the blood in that of the other. The remaining two medicines, with serpentaria, appear to possess the qualities of stimulant diaphoretics rather than those of simple stimulants. The ensuing remarks on the general use of stimulants will therefore be considered as primarily having reference to the operation of alcoholic liquors alone, and to other agents in so far only as their stimulant element is involved. That element exists in some narcotics and in a larger number of antispasmodics, but in none of these medicines does it constitute the chief agent of their therapeutical power. It must be admitted, nevertheless, that nearly all antispasmodics are general stimulants, and that this is emphatically true in the case of the various ethers and other anæsthetics, some of which, indeed, are frequently employed for their directly stimulant operation in the same manner as alcohol. It is also certain that in large doses alcohol is not a stimulant but an anæsthetic and a narcotic. These facts may be added to the reasons elsewhere assigned which demonstrate the impossibility of forming a rigidly accurate physiological classification of the materia medica. The dose, degree of concentration, etc., of the medicine, and the natural susceptibility or the existing condition of the patient, may modify the action of medicine so radically as to render it, under varying circumstances, the very opposite of itself.

Stimulant (from *stimulus*, a spur or goad) is a term applied to all medicinal agents which directly increase vital activity, and, as before stated, the epithet general is given to those stimulants which directly augment the vital activity of the whole economy. Food and oxygen are the essential stimuli of the living organism, the one supplying the means of the primary, and the other, those of the secondary digestion, and both together setting on foot the movements by which we recognize the presence of life, and without some degree of which it is difficult, if not impossible, to conceive that life exists. Hybernating animals and insects may give no evidence of vitality by motion, yet we know that they consume the store of carbonaceous matter which instinct has taught them to provide for their long sleep. The grain of wheat which germinates under the warm rays of the sun, after reposing for thousands of years in the darkness of an Egyptian tomb, must have an aliment for the life of the germ that is in it, how incalculably small soever the store of it may be, and however sparing its consumption; for to believe otherwise, to suppose that the life of the seed is merely potential,

and is substantively created by the access of light, heat, and moisture, is opposed to all analogy and rational induction. To the apparently dead seed these influences are the conditions of its development, they are the stimuli which arouse it from its state of suspended animation. Under the influence of the normal stimulants, food and oxygen, and of the caloric developed by their reactions, as well as by that derived from natural and artificial sources, the functions of the organism acquire a certain development and attain a certain degree of strength which are almost as various as individual men. Indeed their vigor is subject to perpetual mutations even in the same individual; by day, by night, at rest, in exercise, feasting or fasting, it is incessantly changing with the supply of nutritive material, the waste of the organs, and, perhaps, even independently of these to some extent, with the intensity and amount of nervous power determined by the nature and degree of the mind's action. Nevertheless, there is in the case of every individual a certain average condition which may be called his state of health, and in which the variations of vital power oscillate between known extremes.

In disease the susceptibility to natural stimuli is changed. In the greater number of cases it is augmented, and, indeed, is rarely diminished except when profound alterations have taken place in the nutritive function, or in the central organs of the nervous system. Of this fact illustrations will be offered in the sequel. It is more important, in this place, to observe that by a law of the human economy the repeated impressions of a stimulus produce progressively feebler results. There is scarcely any exception to this law. All our senses are, to use the common and expressive term, *blunted* by the repetition of the same impression upon them; every organ gradually becomes insensible to operations which at first may powerfully have excited it; even the affections lose their freshness and the passions their fire; there is, in fact, nothing but pure intelligence which appears permanently and almost without limit to have its powers and susceptibilities increased by exercise. Yet excessive action even of the mind exhausts the vigor of the brain for a season, or may entail the permanent hebetude of its faculties. Hence it is that not only stimuli which produce a local impression exclusively or chiefly, but those also which, like the subjects of the present chapter, are general and diffusible in their operation, tend by degrees to exhaust the susceptibility of the system to their influence. If a protracted administration of them becomes necessary, their doses must usually be increased, even in cases where they have not been used as habitual stimulants in health. But, where they have been so employed, and particularly when this has been done intemperately, larger quantities must be administered, not only to produce a given degree of stimulation, but even for the purpose of sustaining the strength at a point consistent with the patient's safety. No fact is more familiar than that drunkards tend to sink under the attacks of all grave diseases, and especially under the action of causes which, like traumatic injuries, inflict a shock upon the

nervous system. No matter what the local condition may be, how extensive soever the inflammation of the lungs, for instance, or severe the compound fracture, an essential condition of cure is the administration of alcoholic stimuli in at least the quantities habitually consumed by the patient. Without this precaution not only is there great danger that the strength will become speedily exhausted and life itself be sacrificed, but as a prelude to this result complete derangement of the nervous system may occur in the form of *delirium tremens*. Should this affection break out, its most efficient remedy is also an alcoholic stimulant. It is chiefly an exaggerated degree of that ataxia which every drunkard experiences when entirely free from the influence of his potations, the tremulousness of the hands, the uncertain gait, the wandering look, and the infirmity of purpose, to avoid which, and, in his own expressive phraseology, to "steady the nerves," he is obliged to employ another portion of the mischievous cordial to which he has sacrificed his independence.

This disorder of the nervous system, this *ataxia*, is met with in various diseases, and, in fact, constitutes one of the morbid states which may be superadded to almost any original affection. It presents itself constantly as an element of the constitutionally nervous state, or the nervous diathesis, but it is then more appropriately treated by means of antispasmodics; because of the two elements which are usually conjoined in this state, excitability and weakness, the former is disproportionately greater than the latter. Not so, however, in the adynamic types of fever, which present loss of power as their primary and prevailing element, and ataxia chiefly as a secondary phenomenon. In such affections the influence of alcoholic stimulants is precisely of the same nature as in the state of depression, exhaustion, and nervousness which immediately succeeds the suspension of the drunkard's libations; they give tone to the system, and by doing so allay its nervous disorder. The greatest strength is everywhere associated with repose, and mobility is usually an indication of weakness. This is plainly illustrated by the contrasts which are presented by the male and the female sex, and by the robust and the feeble of either sex. In all cases, whenever a cause, mental or material, stimulates the system strongly, it produces an unwonted, even if transient, development of strength.

In adynamic diseases, or rather in the typhoid forms of disease, it is probable that there is something more than a mere loss of strength, that there is an intoxication, a poisoning of the blood, and, perhaps, a vital metamorphosis in this fluid. And whether there be a poison to eliminate, or an organic revolution to be effected in the chemical or physical relations of the elements which compose the blood, time is essential for its accomplishment. Under the most favorable influences the process of cure must be slow and gradual, and whether its conduct have been mainly intrusted to nature, or whether evacuant remedies have been made use of in its early stages, the period arrives when, with more or less clouding of the faculties, feebleness pervades all of the organs, and especially

those of animal life. Then it is that, with due reference to the probable duration of the disease, alcoholic stimulants are indicated. Their management requires considerable tact, not only in regard to the period of commencing and of discontinuing their use, but still more in relation to their doses and the intervals at which they are prescribed. Nothing in fevers tends to exhaust the strength more rapidly than excessive quantities of alcoholic medicines. If their stimulation exceeds the normal bounds, if, in short, any degree of intoxication is produced, it must necessarily be followed by a proportionate degree of depression and exhaustion. The difficulty of preserving due moderation in this matter is enhanced by the altered susceptibility to alcoholic stimulants manifested in the diseases referred to. It really seems as if in some cases there were no other limit to the quantity of them which can be borne, than the capacity of the stomach to retain it; but, on the other hand, the limits of safety are usually much narrower than this. They are not easily determined except by experiment, which should always have in view the maximum amount that can be taken without producing morbid effects within a determinate period. The individual doses ought, on the other hand, to be relatively small; for by this means their stimulant action is maintained and their sedative consequences avoided.

But the benefits of alcoholic medicines are not limited to their stimulant influence. They are food, according to the present chemical doctrines, in the sense that they restrict the waste of the body, and therefore indirectly sustain the strength. That is to say, they afford a large quantity of carbon and hydrogen with which the inspired oxygen combines instead of with the tissues themselves. It would, however, be very unwise to trust to them for the patient's entire support. On the contrary, the condition that calls for their employment is one that food is also adapted to cure, and hence it forms a necessary complement of the stimulant treatment of the typhoid state. It may, to some extent, be regarded as sustaining by its steadier strength the advances towards cure made by the more active but interrupted efforts of alcoholic stimuli.

Apart from the typhoid types of disease in which diffusible stimulants display such precious qualities, there are two conditions in which they are also of signal utility. These are the forming stage and the decline of many affections. In the greater number of inflammations, as well as of some general diseases, the first sensible morbid act is a chill, one of the phenomena of which is a tendency of the blood inwards, producing congestion of the internal organs. If this movement is slight, as it is apt to be when it is the forerunner of inflammations of moderate extent or degree, as in the case of coryza, tonsillitis, bronchitis, muscular rheumatism, etc., the stimulant operation of hot alcoholic drinks, particularly if seconded by external heat in the form of pediluvia, or the general warm bath, will frequently dissipate the gathering inflammation, and produce a resolution of the attack. But if the affection be one of considerable energy, such remedies may be inadequate to arrest

its development, and, in that case, the reaction which necessarily succeeds the initial chill will be aggravated by the stimulants that have been administered. The fact may be difficult of explanation, but it is none the less established by experience, that whenever the state of disease is one of great depression, heat is of all stimuli the least efficient in overcoming it. In frost-bite, in the cold stage of algid intermittents, in the collapse of epidemic cholera, cold applications, intense in degree and exceedingly brief in their contact, are remedies far more efficient than any degree of heat above the average temperature of the body. Under the circumstances, these agents appear to act very much as the hot bath and alcoholic liquors do when no abnormal coldness exists.

The only other condition it is proposed to mention, for which diffusible stimulants are important remedies, is that of pure exhaustion. Exhaustion may be produced by powerful impressions made upon the nervous system, by sudden shock, which has already been referred to, or by prolonged fatigue. In the latter case, it is a matter of daily experience that these agents dissipate the sense of weariness and brace the system for renewed exertion. It is equally well known, although too little regarded, that an habitual resort to such stimulants robs them of their original utility, and is apt to induce habits of intemperance in their use. In many diseases, however, of chronic course, or attended with wasting discharges, or during convalescence from acute affections which have wasted the flesh and strength, these remedies are in the highest degree serviceable, and often, indeed, appear to be essential to the cure. Not that they are directly curative. The organs are usually in a state of atony, or apathy, if the expression may be allowed, which appears to be the immediate effect of a greater or less destruction of their organic constituents, shown by a wasting of their substance, and more remotely by a diminished supply of blood. The composition of this fluid is probably altered by the loss of a portion of its red disks, but its quantity is also evidently reduced if we but examine the pallid skin, and the thin, pale veins with which it is marbled. The stomach and intestines participating in the general debility, their secretions are scanty and of feeble power, the food is eaten without appetite or relish, and is neither reduced to a homogeneous chyle, nor assimilated. Bitter tonics, as it is elsewhere stated, tend to remove this condition, but they are seldom sufficient, if for no other reason than because their action is chiefly local. Alcoholic stimulants, on the other hand, are absorbed, and everywhere throughout the body promote the excretion of effete tissues and quicken the demand for new supplies of nutritive material; everywhere throughout the system they arouse the dormant powers, excite a craving for food, hasten its digestion, promote its assimilation, and thus become purveyors to the nutrition of all the organs. These effects, which are directly curative in acute diseases, are the means of prolonging life, and of rendering it tolerable, in chronic affections for the ultimate cure of which time and the protracted use of appropriate remedies are necessary,

or in which the inevitable termination in death can only be postponed. Such a one is consumption of the lungs, the most common by far of all the ordinary causes of death. In that disease alcoholic stimulants appear to form a natural harmony with fatty nutriment and muscular exercise, the only means which have yet been discovered either for its essential mitigation or its cure.

CALOR.—Heat.

The term heat is used as a synonyme of *caloric*, and is also applied to the sensation which caloric produces. Thus it stands both for cause and effect. But this double application of the term is not attended with inconvenience in ordinary language, for we know nothing of caloric except through the phenomena of heat.

It is probable that caloric exists in combination with all matter. Experimentally, heat is developed under a great variety of circumstances. Its most abundant source is the sun, which, by the concentration of its rays, manifests a prodigious calorific power. It is developed also by friction, percussion, and all other modes of producing rapid molecular movement in bodies. All changes of matter from a rarer to a denser condition are accompanied by a disengagement of heat—as when a gas or vapor is condensed into a liquid, and this again into the solid form. All organic actions involve more or less of such a series of changes, and therefore become sources of heat; and on this account, partly, all living organisms are, within certain limits, enabled to maintain a temperature above that in which they ordinarily exist, and to resist the destructive action of cold. Independently of a change of density, many chemical molecular changes evolve heat; and if combustion be included among such changes, they may be said to comprise the principal sources of heat. Electricity, also, whether it be developed by friction, or by chemical action, or, in less degree, by magnetic induction, is also to be ranked among the conditions which develop heat. Indeed, the tendency of recent science is to regard, not only heat and electricity, but also light, as modes of motion convertible into one another, and identical in essence.

Heat is the universal stimulant of the animal and vegetable organism, and is everywhere found in close relation to life. Indeed, in all ages, flame, the representative of heat, has been the chosen emblem of life. Like all other stimulants, it is no less destructive in excess than it is favorable to vital action when restrained within due limits.

In studying the influence of heat upon the animal economy, we must remember that it varies with the conditions under which it operates, and particularly with the degree of humidity to which the body is at the same time subjected. Hence, in order to simplify the subject as much as possible, we shall first of all treat of the action of dry heat, then of heat combined with watery vapor, and finally of water itself, at and above the temperature of the body.

Of Dry Heat.

Under this head we shall consider the mode of action and the phenomena of radiated solar and artificial heat, of hot dry air, and of heated solids.

All of the organs perform their functions most perfectly when the body is at its normal temperature. If this is depressed, so is the activity of the functions; on the other hand, if it is carried beyond a certain limit, the operations of the economy are equally embarrassed; and if raised to the highest point, it arrests these movements by deranging the animal mechanism, and ultimately by destroying its structure.

Within the range of temperature compatible with health, the action of heat upon the tissues is to produce their expansion and relaxation; the bloodvessels are enlarged, the contour of the body becomes more rounded, and the skin softer and more pliant. At the same time the nervous energy is depressed, and muscular contraction becomes less vigorous.

If the heat is much above the average and customary degree, it develops in the whole system a great susceptibility to external impressions. Friction is more apt to produce excoriation of the skin, and blisters draw more speedily; all the reflex actions of the economy and the muscular irritability are more easily excited. Humboldt found that a frog's heart, that had for twenty minutes been removed from its connections and ceased to beat, and which was but feebly excited by galvanic stimulus, lost its contractility entirely when placed in water at 50° F., but began anew to pulsate when it was immersed in water at 127° F.

Warm air promotes the secretions, and the perspiration in particular, and that in proportion to the warmth and dryness of the air. Yet the increase of the perspiration is not then as visible as when the air is warm and moist; on the contrary, the secretion of the skin is absorbed by the air and removed as rapidly as it forms. If, however, the temperature is very high, it excites the skin to the secretion of liquid more rapidly than it can be removed by evaporation. In either case, however, the evaporation tends to produce cold, and thereby reduce the temperature of the skin, and render the body capable of enduring a higher degree of heat than could otherwise be borne. To this protective power a limit is imposed by the amount of moisture contained in the body; and hence if the air be extremely dry and hot, and its action greatly prolonged, it robs the organs of the moisture essential to their free play, and becomes a cause of suffering and disease.

When the action of heat of a high grade is limited to a small portion of the body, a sensation of warmth and burning is excited, the bloodvessels are congested, the cutis swells, and erythema or vesication ensues, followed by desquamation. A still higher temperature produces in addition, subcutaneous effusion and superficial gangrene; and a degree of heat yet more extreme decomposes and carbonizes the tissues to which it is applied.

When heat of a moderate degree acts upon the organism reduced by disease below the normal temperature, it becomes a quickening and strengthening agent. This is strikingly shown during convalescence, when there is a marked susceptibility to cold, but when also the feelings and strength revive under the genial influence of a sunny day, or of a cheerful fire. In like manner the development of disease may sometimes be arrested by counteracting the depression and coldness which usher in the attack.

Insolation.—Solar and artificial heat combined with light are transmitted differently by different bodies. The sun's rays penetrate the atmosphere and all colorless gases without warming them. White bodies reflect nearly all the calorific as well as luminous rays, while black substances absorb nearly all of both. Hence, in popular parlance, dark-colored clothing is warmer than light-colored.

When the sun's rays are moderately warm, they excite in the skin and throughout the body a quickening sensation, particularly if, as already remarked, the temperature of the body have been previously lowered by sickness. If the sun's heat increases, it may cause the skin to be reddened, swollen, and painful, and even blistered, the cuticle generally desquamating in consequence. If the head is directly exposed to the heat of the sun, the result may be sunstroke, an affection which is often fatal, and in which there is generally insensibility, sometimes convulsions, and sometimes apoplexy.

The temperature in the sunshine which shall be suitable in a given case of disease, can hardly be determined beforehand; it depends mainly on the sensibility of the patient; in general, a place should be selected which is perfectly dry, open towards the south, and shielded from the northern winds, so that the patient shall enjoy the reflected as well as the direct rays of the sun. At the same time his head should be protected from their action, and the feet kept warm and dry.

Warm and Dry Air.—Dry is a relative, and not an absolute term as applied to air in its present connections. Air is said to be dry when it contains but little moisture in proportion to its temperature. The warmer it is the greater is its capacity for moisture. Thus, at the medium state of the barometer, 760 parts of atmospheric air, when they have been long in contact with water,

at —4° F.	contain	1.33	parts of watery vapor.[1]
+ 13° F.	"	2.63	"
32° F.	"	5.06	"
50° F.	"	9.48	"
68° F.	"	17.41	"
86° F.	"	30.64	"
122° F.	"	88.74	"
194° F.	"	525.28	"

[1] Mitscherlich, op. cit., ii. 392.

Hence the warmer the atmosphere, the more abundant must be the exhalation of moisture from the lungs and skin.

The general action of warm dry air upon the economy resembles that of radiated heat. At temperatures compatible with the free performance of its functions, the body shows the results of a stimulant influence, and especially in a great increase of the perspiration. The evaporation of this liquid absorbs so large a portion of caloric, that the normal temperature of the skin is little, if at all exceeded.

When, says Rapou,[1] the body is inclosed in an appropriate apparatus heated to 122° F., the heat at first is hardly perceptible, but by degrees the skin grows warm, the face is somewhat flushed, and the pulse rather fuller and more frequent. After a while a gentle moisture breaks out. At 131° F. the heat is rather annoying, but yet tolerable; it causes smarting pain wherever there is a scratch or pimple; the general and capillary circulations are quickened; the skin grows red, and, as well as the subcutaneous cellular tissue, is swollen by the afflux of blood; the pulse is fuller and somewhat more frequent; the face is injected, and perspiration breaks out. This latter becomes more abundant after the bath, if the patient is warmly covered in bed, and uses warm drinks.

The first sensation experienced on entering a hot-air bath at 150° to 160° F., is a sort of constriction of the integument; sometimes there follows a smarting and annoying pruritus over the whole body, but more particularly upon the upper part of the breast, around the umbilicus, and on the scrotum; the latter contracts firmly. The pulse is at first small and hurried, and the respiration is sometimes embarrassed; the head seems as if it were compressed by a tight band. These primary phenomena are succeeded by a sort of reaction; the skin is burning hot, the pulse is frequent and full, the temporal arteries throb, and sometimes the veins of the forehead are swollen. A copious sweat breaks out, particularly upon the head; the mouth is sometimes dry, and the thirst urgent. A slight heaviness of the head is experienced, which, like the perspiration, continues for some hours after the bath. The latter should not be prolonged beyond twenty-five or thirty minutes.

If the lower half only of the body is inclosed in the hot-air box, the perspiration breaks out simultaneously on all parts of the skin, and even more promptly upon those which are not directly exposed to the heat, provided that they are well protected from the air. In this manner there need be no fear of any unpleasant effects upon the head. Such baths are preferable for persons of a sanguine or irritable temperament, and when it is desirable to limit the direct action to the lower part of the body.

Dry and warm air acts upon the lungs as well as upon the skin. This is felt in a peculiar manner in dwelling-houses warmed by hot-air furnaces. If an apartment is heated to 65° or 68° F., a person in good health, and in ordinary clothing, feels comfortable, and

[1] Traité de la méthode fumigatoire, p. 65, quoted in Trousseau and Pidoux, 5th ed. ii. 549.

experiences no immediate inconvenience. But the atmosphere contains a much smaller proportion of vapor than if the air were warmed to the same degree by a stove or open fireplace. In this manner a great demand is made upon the system to supply the air with moisture, the skin and pulmonary mucous membrane are dried, and a condition is induced which is expressed in irritability of the nervous system, paleness, and susceptibility of the skin to cold, liability to pulmonary diseases, and, in a word, deterioration of all the functions.

It is to be remarked that when the atmosphere in which we dwell continues for some time at a high temperature, the perspiration is increased, the urine becomes scantier and more concentrated, and the alvine evacuations drier and less frequent. The thirst, also, is more urgent, and the appetite fails. These effects are constantly observed during the prolonged heats of summer. Then, and in hot climates generally, the secretion of bile augments, and bilious and hepatic diseases, with gastric derangements, diarrhœas, and dysenteries prevail. At the same time muscular strength declines, and there is a general inactivity of all the faculties, both mental and bodily.

When we are surrounded with and breathe air at a temperature of 100° to 120° F., besides experiencing the symptoms already ascribed to the hot-air bath, the respiratory passages become dry, the breathing is more hurried than usual and also more laborious. After a time restlessness and oppression, weariness, mental lassitude, and fulness of the head are experienced. If the clothing is so thick as to prevent cooling by exhalation, the symptoms are still more marked, and the greatest relief is obtained by exposing the skin completely to the air. As will presently be seen, when the heat is more intense, clothing serves to protect the body from its operation.

At still more elevated temperatures the symptoms described become more decided, and assume a threatening aspect, yet such degrees of heat may still for a short time be sustained. Tillet speaks of a baker's girl, who remained fourteen minutes, without injury, in an oven at 246° F. Berger supported a temperature of 229° F., for seven minutes. Fordyce, Bladgen, and several others remained for seven minutes in dry air between 150° to 212° F. They found that their presence lowered the temperature of the surrounding air, and in comparison with it their breath felt cool. The heat was disagreeable, particularly upon the face and legs, the pulse rose from 92 to 100, the respiration was not oppressed, and the temperature of the skin in the axilla and under the tongue was 98° F. The perspiration was not always sensible, owing chiefly to its evaporation, but the experimenters concluded that their clothing prevented the access of the hot air to the skin. Bladgen remained for eight minutes in dry air at a temperature of 240° to 260° F., and experienced a disagreeable but not an absolutely painful sense of heat, and only a moderate degree of perspiration. After the seventh minute the breathing was laborious and painful, and the

pulse rose to 144, but no permanent inconvenience ensued. Without clothing, this experimenter felt a more decided sense of heat, but at the expiration of twelve minutes, the sense of præcordial oppression subsided, owing, probably, to the outbreak of a profuse perspiration which completely exhausted him. In Dobson's experiments a young man remained for twenty minutes without great inconvenience in an oven, the air in which was at 210° F., but his pulse beat 164 in a minute.

Roman and Oriental Baths.—Although the system of bathing in vogue among the Romans was not exclusively confined to the use of the hot-air bath, yet as this formed the first and an essential step in the process, the subject may be appropriately noticed in this place. The account furnished by Galen of this subject is very complete. From him we learn that the first in the suite of bathing-rooms was the *Laconicum*, filled with hot air, by which the skin was stimulated, and profuse perspiration excited. The next chamber, called *Calidarium*, contained a large reservoir of hot water in which bathers remained for a long time. To an excessive use of this apartment was charged not only physical enervation but the moral corruption which led ultimately to the discontinuance of public baths in Rome as well as in more northern countries where the Romans introduced them, and where they continued until a very recent date. The *Frigidarium* was a cold plunge bath, intended to brace the system after the relaxing operation of the warm bath. Finally, in the *Tepidarium*, which was a moderately warmed apartment, the bather was dried and rubbed, after which he was anointed with hot oil to protect him on issuing into the outer air. Galen informs us that the intention of these successive operations was to purge the body through the skin, to cleanse the integument of its excrementitious coating, to renew the moisture of which the sweating process had deprived the body, to restore the tone of the relaxed tissues, and, finally, to preserve the bather from catching cold. The shampooing and scrubbing, which form such important adjuncts of the Turkish bath, were not in ordinary use among the Romans, although they were occasionally employed in special conditions of the skin or of the system generally.

The *Oriental*, or, as it is usually called, the *Turkish bath*, is a modification of the Roman bath. The temperature of the first chamber is about 77° F. There the bather deposits his clothes before entering the hot chambers, and, on returning, remains in it to cool before going into the open air. The succeeding apartment is at a temperature of about 95° F., and there he reclines for some time, drinking hot coffee, or smoking, until he is in a fit condition for entering the third chamber, the temperature of which is about 104° F. In it the bather is shampooed, and the impurities of the skin are removed by means of a goat's hair glove, and by copious ablutions with soap and hot water; after which he returns to the second chamber, where he is wrapped in warm towels and wiped dry. Finally, he passes into the first chamber, where he reclines for some time, swathed in towels, while he drinks sherbet or coffee, or smokes, until he is sufficiently cooled to quit the house.

The baths in England called Oriental have the same succession of apartments, but the air in them is at a much higher temperature, viz., 120° in the second, and 160° or 170° in the third, an excess of heat which is not only unnecessary for sanitary purposes, but which may become the cause of serious mischief. It is also to be noticed that the Oriental baths, and the imitations of them, are wanting in a very important portion of the Roman method, viz., the cold plunge-bath, by which the system was invigorated after it had been depurated and relaxed by the action of hot air. It is to be feared that the benefits to be derived from a revival of the ancient system of bathing will be neutralized or converted into positive evils, if these cardinal elements are neglected, while the bath itself, instead of being both luxurious and invigorating, must become an infliction both painful and deleterious.

Uses of Dry Heat.—Several diseases are benefited by the judicious application of dry heat both natural and artificial. One of these is *rheumatism.* The sensitiveness of rheumatic patients to cold is a clear indication for the use of warm air in their treatment, at least in the subacute and chronic forms of the disease. Appropriate clothing, a dry and well-warmed chamber, or a winter's residence in a southern climate is essential to the cure of the disease in many cases. Sometimes the hot-air bath, by provoking copious perspiration, has appeared to promote a cure; but in this respect it is inferior to the vapor bath. In general *dropsy*, especially when it depends on renal disease, the hot-air bath is often of essential service, and in scarlatinous dropsy it is often curative. We have repeatedly alleviated this effect of chronic Bright's disease by using the vapor of burning alcohol conveyed under the bedclothes by means of an appropriate funnel and tube made of tin. It usually brings on profuse sweating and a proportionate diminution of the dropsy and of the albuminous contents of the urine. Still more efficient is the Turkish bath. A case is reported in which the albumen was so abundant in the urine that this fluid became nearly solid on the application of heat, and the patient also had an intermitting pulse and dropsy. He at first took two baths daily, of two hours each, of the temperature of 130° to 140° F., and after each of them a cold shower-bath. So marked was the improvement under this regimen that he prolonged his life for more than four years by maintaining it.[1] The influence of a mild climate in retarding or arresting the development of *pulmonary consumption* is well known, and its efficacy, in spite of apparent contradictions, continues to be attested by constantly recurring examples. Not only is it proved by those phthisical patients who have had life indefinitely prolonged, by spending every winter in a warm climate, but by many others who have been equally fortunate in consequence of passing the cold season in apartments carefully warmed and ventilated and exposed to the southern sun. The prevalence of *scrofula* in low, damp, and ill-ventilated localities has led to its

[1] Brit. Med. Journ., Feb. 1871, p. 194.

treatment by fresh, dry, and warm air, and with a certain degree of success. But the influence of such air is more plainly seen in the exemption from scrofula of places where it is enjoyed.

The suggestion of Dr. B. W. Richardson, of London, that persons apparently dead by *drowning* might probably be brought to life by simply exposing them to the action of air at a temperature of 130° to 140° F. was acted upon in this country by Dr. J. G. Richardson. A child having been apparently *stillborn*, for it gave no signs of life except a faint pulsation of the heart, all the usual methods of resuscitation were employed in vain, when the child's limbs were exposed to a warm fire, and, when thoroughly heated, attempts were made by an appropriate manipulation of them to force the warmed blood towards the heart. The pulsations of this organ were speedily renewed, breathing was established, the flaccid limbs exhibited slight movements, and the blue color of the skin was exchanged for a pinkish hue. It is probable that life would have been permanently established had not an officious old woman strangled the child with molasses and water.[1]

Various methods are employed in the application of dry heat. *Linen*, *cotton*, or *woollen cloths*, heated in a stove, or at an open fireplace or furnace flue, are constantly used as local applications to the abdomen in colic, to the face in toothache, to the feet or to the whole body when a chill is threatening. *Hot sand*, *salt*, *ashes*, or *clay*, contained in bags, hot bricks wrapped in woollen cloths, *tin cases* or *bottles* containing hot water, and applied to various parts of the body, are sometimes used in the cold stage of fevers, of cholera, etc.; in rheumatism, paralysis, and gout; and in restoring asphyxiated persons to life. A homely but efficient means of treating local forms of *muscular rheumatism*, such as stiff neck, lumbago, etc., consists in passing repeatedly over the skin of the affected part protected with a flannel cloth, a hot flat-iron. Dr. Arnott has suggested an apparatus for the application of heat, which consists of a gum-elastic bag furnished with stopcocks, and connected on the one side with a reservoir of water warmed by a spirit-lamp, and on the other with a waste-pipe. This bladder or bag can be laid upon the abdomen, or other affected part.[2] A convenient form of hot-air bath consists in a chair, under which several large spirit-lamps are placed, or even alcohol burning in a wide and somewhat deep vessel. The patient being seated, is enveloped, as well as the chair, with blankets secured around his neck. The air speedily becomes heated, and produces copious perspiration. The lower part of the covering should be raised from time to time to admit air, and allow the carbonic acid gas to escape.

M. Guyot, observing that in hot, dry countries—as in Egypt, according to the report of Larrey—all wounds heal with marvellous rapidity, performed numerous experiments upon animals, inflicting wounds upon them, and then exposing them to the constant and

[1] Am. Journ. of Med. Sci., Jan. 1867, p. 127.
[2] Lancet, June, 1842, p. 439.

regular action of heat. He found that his results corroborated the statements which have been referred to, and which are further confirmed by the testimony of Dr. Erasmus Wilson. He had also an opportunity of studying the influence of dry air upon the cicatrization of wounds in the case of patients who had undergone surgical operations at the Hôtel Dieu in Paris. His most important conclusions are that wounds without any dressing heal more rapidly in air at a temperature of 86° F. than at a lower temperature with or without dressing. In the experiments referred to, cicatrization took place without inflammation or suppuration. In dry air, at the temperature mentioned, ulcers were found to heal with great rapidity.[1] Dr. Wilson gives a very glowing narrative of the effects produced by the hot-air bath in depurating the system and protecting it against the impression of cold, and in curing several forms of *cutaneous disease*. He recommends a temperature of about 135° F. Such baths have been used with striking success in the treatment of *albuminuria*.

In the forms of dry heat still to be noticed, the temperature is so high as to produce disorganization of the skin; their direct action is therefore local and very restricted. They are stimulant in virtue of the pain they excite, revulsive and counter-irritant by means of the local fluxionary movement they occasion. The first and most potent is the *actual cautery*.

The actual cautery consists in the application to portions of the integument of iron bodies, of various shapes and sizes, at a white heat. Its operation depends upon whether it is brought into actual contact with the tissues or only near to them, and also upon the duration of the action. If the heated iron approaches without touching the integument, it produces vesication or inflammation; if it is moved lightly and rapidly upon a part, it destroys the tissues superficially; if applied firmly without motion, it destroys completely and rapidly the whole thickness of the skin, and even the parts beneath it. This application causes severe but not protracted pain, and is followed by general excitement or fever. The parts destroyed by the cautery gradually separate from the surrounding sound tissues, leaving an open suppurating sore.

The heated iron is employed to *destroy diseased structures*, to arrest *hemorrhage*, and sometimes as a *revulsive*. *Poisoned wounds*, as those of serpents and mad dogs, are sometimes treated in this manner;[2] but the caustic alkali is preferable, because it penetrates more thoroughly into the depths of the wound, while it is equally effectual in destroying the virus. *Fungous excrescences*, *warts*, *condylomata*, *gangrenous ulcers*, *carbuncles*, *varicose tumors*, etc., are sometimes cured by the actual cautery; but in the case of the last-named affection the galvanic cautery is preferable. The hot iron is also used

[1] Archives Gén., 2ème sér., viii. 273; 3ème sér., ix. 368; Traité de l'Incubation, par Jules Guyot, Paris, 1840; and Examen critique de l'Incubation, par E. Baudot, Paris, 1858.

[2] Bonnet, Bull. de Thérap., liv. 184.

to promote the healing of *fistulous ulcers*, and those covered with flabby granulations, or which discharge an ichorous fluid. It is, moreover, sometimes preferable to any other mode of *arresting hemorrhage* in cases where ligature of the bleeding vessel is impracticable and compression unavailing. It coagulates the blood in the vessel, and forms, externally to it, a crust, which still further controls the bleeding. Larrey advised the actual cautery to be applied to the wound in cases of *traumatic tetanus*. Rémy reports a case in which spasms supervened on the ninth day after the receipt of a wound of the temple, and which was cured by cauterizing the cicatrix, in its whole extent, with an iron brought to a white heat.[1] Cotugno employed it in *sciatica* and *crural neuralgia*, by cauterizing the skin over the sciatic nerve between the tuberosity of the ischium and the great trochanter, over the origin of the peroneal nerve, etc.

Mayor's hammer acts in a similar manner. A hammer is plunged into boiling water until its temperature equals that of the water itself, and then is applied to the skin. It occasions acute pain, and an eschar is produced. At a temperature of 176° F. it still forms an eschar, and at 158° F. it gives rise to a phlycten, and destroys at the same time a superficial layer of the cutis. Even at 150° the same result is produced if the iron is held for some time in contact with the skin. At 140° the pain is still almost intolerable, and vesication ensues. At 130° there is permanent rubefaction; and at 120° the rubefaction continues only for about an hour.[2] Hot coals have been recommended as a cautery by Faure, and also by Lepeyre and Lecomte, who employed burning glasses to stimulate indolent and foul ulcers, certain cutaneous eruptions, etc.[3]

The *moxa* is a form of cautery which consists essentially of a small cylinder of cotton, or other vegetable fibre, which, by its combustion upon the skin, produces vesication or an eschar. The substances employed in making it have been various; such as the down of various species of artemisia; the agaric of the oak; the pith of the reed, or of the sunflower; flax, and also hemp, impregnated with some combustible material; dried moss or wood; a roll of fine linen saturated with chlorate of potassa, etc. It is said to have been long employed by Oriental nations, particularly the Japanese and Chinese, from whom it was introduced into Europe by the Portuguese; but it was also used by the Egyptians, the Persians, and the Laplanders.[4]

According to Larrey, the moxa cylinder should be about an inch long, and from a quarter to half inch in diameter. One end of it is applied to the skin, and held in its place by a pair of forceps, or a *porte-moxa*, while the opposite end is lighted, and the surrounding skin protected by a damp rag, a piece of sticking plaster, or a piece of paper saturated with alum and dried, having an aper-

[1] Lond. Med. Gaz., Sept. 1849, p. 555.
[2] Trousseau and Pidoux, op. cit., ii. 556.
[3] Mérat and De Lens, Dict. de Thérap., vi. 661.
[4] Ainslie, Materia Indica, i. 482; ii. 195.

ture in its centre. Combustion is maintained in activity by the breath, or by a pair of bellows, until the whole of the cylinder is consumed. To prevent deep inflammation and profuse suppuration, liquor ammoniæ should be immediately afterwards applied.[1] In some cases it is preferred to move the cylinder about within a small area, without allowing any one spot to be deeply involved; or again, to hold it very near, but without touching the skin; or finally to remove it when the fire is at the distance of a line or two from the skin. Mr. Boyle used the moxa without bringing it into contact with the skin at all, but lighting the cylinder at *both* ends, applied it within an inch and a half of the part, or less, so as to cause a slight degree of pain.[2] The moxa should not be applied where the skin is the only covering of the bone, tendon, ligament, or cartilage, nor to the mammæ, genital organs, or abdomen. During its application, the first degree of heat causes the patient an agreeable rather than a painful sensation. This is gradually increased until the pain becomes tolerably severe. Mr. Wallace says: "I have had innumerable opportunities of ascertaining the opinions of patients respecting the comparative pain produced by moxa, caustic issues, and blisters, and I have never met with a single instance in which the moxa, when properly applied, has not been considered the mildest remedy by many degrees."[3] Kæmpfer, in his History of Japan, quoted by the last-named author, says, "The pain is not very considerable, and falls very far short of that which is occasioned by other caustics, or actual cauteries;" and Sir W. Temple, who wrote an essay on its use in the cure of gout, declares that the pain ceases as soon as the fire is out.[4]

In regard to the *modus operandi* of moxa, those who have most employed the remedy consider that it differs from that of hot iron. Larrey supposed that it communicates to the surrounding parts, not only heat, but a very active and volatile principle which substances like cotton furnish while they are burning, and that the excitation and irritation resulting from these two causes extend gradually from the superficial to the deeper tissues. Boyle and Wallace also held that its utility is quite independent of any local inflammation, or any serous or purulent discharge, and indeed that it acts most beneficially when it produces the least disorganization of the cutis.

The *remedial uses* of moxa are the same as those of counter-irritant agents in general. It seems to have been peculiarly effectual in the following diseases: In affections of the *superficial joints*, as the knee and wrist, particularly in stiffness resulting from rheumatism; in *white swelling*, and also in *coxalgia;* in *diseases of the vertebræ* and their ligaments, and in lumbar abscess; in *neuralgia* and *sciatica;* in *lumbago*, *rheumatic gout*, and *paralysis;* and finally, in *chronic bronchitis.*

[1] Larrey's Surgical Essays, by Revere, p. 21.
[2] A Treatise on Moxa, etc., Lond. 1825, p. 96.
[3] A Physiological Enquiry Respecting the Action of Moxa (Dublin, 1827), p. 13.
[4] Works, iii 252.

Of Heat combined with Watery Vapor.

The temperature of the body may be elevated by the reception of external heat, or lowered by the loss of its own caloric. This loss will depend upon the conducting power of the clothing worn, but also in a great degree upon the amount of moisture in the atmosphere. When the latter is in excess, and the temperature high, evaporation, which is a cooling process, is diminished, and the temperature of the body is raised; and if the air is saturated with moisture, the elasticity of the skin is impaired, and its exhalation suspended. But if the atmospheric moisture have a temperature much below that of the body, it abstracts heat from the latter with great rapidity, both by the cutaneous surface and the lungs, while it impedes or prevents the elimination of effete materials by these outlets.

Undoubtedly a certain degree of atmospheric heat and humidity is most conducive to health, but it probably varies for different persons, and cannot be scientifically determined. It is quite certain, however, that a moist and hot atmosphere, when long in action, exerts an injurious influence on the health. In like manner a cold and moist atmosphere is a prolific cause of disease. In other words excess of humidity is the one great atmospheric cause of disease. A very humid air at 65° to 70° F. occasions in many persons a sense of discomfort, and in proportion as both heat and moisture increase above this point, the sense of suffering becomes more general and distinct. The perspiration can no longer evaporate, but saturates the clothing and soddens the skin. At a temperature of 75° F., the intestine and kidneys secrete more fluid than usual, and hence diarrhœa is a very frequent occurrence during prolonged heats. At a still higher temperature, however, as of 80° to 90° F., the atmospheric moisture does not prevent a profuse flow of perspiration, while the urine grows scanty and the fæces dry. The appetite for solid food fails, but acidulated liquids and subacid fruits are grateful to the taste. The temperature of the skin is slightly raised, the pulse is soft, but fuller and more frequent, and the veins are prominent. The nervous energy is impaired, the muscles are weak, the fat wastes away, and there is an irresistible inclination to rest and quietness, which any call to exertion, whether of mind or body, painfully disturbs. If this state is long continued, it becomes so far a morbid one that disease is developed in it by very trifling causes. Such is the case in the United States during the "dog days." Diseases of the digestive organs prevail, and often assume characters which denote a radical vitiation of the blood. The degree in which the phenomena which have been described occur depends, in some measure, upon the nature of the clothing. When it is thin, permeable, and made of a good conductor of heat, it permits the evaporation of moisture, and, in so far, promotes bodily comfort, particularly if a current of air passes through it. When the temperature of air saturated with moisture exceeds that of the body, the latter, being relatively cold, precipitates vapor

upon its surface which mingles with the product of its own exhalation, and no evaporation takes place from the skin, which feels hot, and becomes injected and swollen; by degrees the heat appears to penetrate to the internal organs, and the lungs probably contain more blood than usual. The pulse becomes more frequent. Fordyce found that it beat 145 after twenty minutes passed in a vapor bath at 120° F. At a still higher temperature the pulse becomes smaller and more frequent, a sense of oppression at the præcordia is experienced, produced by congestion of the lungs, and, if these organs are diseased, hæmoptysis may ensue. There is also great weariness, with headache, vertigo, syncope, and even apoplexy, in consequence of cerebral congestion resulting from an engorged condition of the right side of the heart. The highest temperature, under the conditions named, which can be borne by a healthy man without serious injury, is still undetermined; but it is certain that a moist atmosphere of 165° to 170° F. can be endured without injury for a very short time only. The rise of the temperature of the body is not exactly in proportion to that of the air and vapor which surround it. Thus, Wiegand found that in a vapor bath at 106° F., a thermometer placed in the mouth rose from 99° to 102° within five minutes, reached 104° when the bath was at 110°, and only gained one degree more when the temperature of the bath attained 117°. In another experiment, the bath being at 115°, the thermometer in the mouth rose from 98° to 104° within ten minutes, and yet marked only 107° when the bath was at 140° F. Even this degree of change in the thermometer may, perhaps, not be wholly due to an increased temperature of the body, but rather to the warm vapor drawn into the mouth through the nose; for when, under conditions otherwise the same, the thermometer is placed in the axilla, it does not indicate so great a degree of change.

As most hot air becomes condensed into water when it comes into contact with the cooler surface of the body, it gives up more caloric, or heats the body more than dry air; and as the evaporation of water from the skin and lungs almost ceases in a moist atmosphere at 99° F., it follows that heat combined with moisture becomes more speedily insupportable than dry heat. Indeed, direct experiment has shown that one may remain for *seven* minutes in dry air at 210° F., and that the temperature of the body will not rise more than one degree. Although a warm moist atmosphere restrains or even arrests cutaneous evaporation, there is, nevertheless, a sensible loss of weight, particularly at high temperatures, in consequence of the profuse perspiration which breaks out, and which, for remedial purposes, is promoted and prolonged by enveloping the body in warm blankets. The urine, meanwhile, becomes scantier, darker, and of a higher specific gravity. If the action of the skin is not maintained, but, on the contrary, is suddenly lowered, or arrested by the operation of cold, the result may be an attack of rheumatism or an inflammation of some internal organ.

Modes of using Warm, Moist Air.—Warm, moist air and watery vapor above 96° F. are applied to the skin and lungs in general baths, or to the skin alone or to limited portions of it or of the mucous membrane. The vapor-bath on a large scale, and properly constructed, consists of a bathing-chamber and anterooms. The bathing-chamber is lined with wood and surrounded by several rows of benches rising one above another, so that on the topmost one the vapor is hottest, and on the others, successively, less so. The steam is generated in Russia by pouring water on heated stones, but elsewhere in a boiler, whence it diffuses itself through the chamber. The temperature of the air varies with the elevation of the benches; on the lowest it does not exceed 96° F., but on the upper it may reach 160° F. A higher temperature is seldom used, on account of the risk attending it. The anterooms, of which there are several, vary in temperature from 65° to 95° F. The bather undresses himself in a room at the lower of these temperatures, and puts on a loose bathing-gown, which, however, he lays aside in an adjoining apartment where the temperature is between 90° and 95° F. He then enters the vapor-bath, placing himself first upon the lowest bench, and gradually reaching the highest. At first, it is advised that this process should not occupy more than fifteen minutes, but after repeated baths it may be prolonged for half an hour or more. After bathing, the patient enters an adjoining apartment, and, partaking of some light, warm drink, remains until gradually he becomes cool; or else, if his object is to provoke a copious diaphoresis, he is wrapped in blankets upon a couch until this process is completed.

The *Russian vapor-bath*, so called, differs from the preceding by the addition of procedures borrowed from the Turks, such as friction, shampooing, flagellation with birch rods softened by soaking in hot water, and affusion with lukewarm, cold, and even ice-cold water. In Russia it is employed as a hygienic even more than as a medicinal agent. Friction is made with flannel cloths well soaped and dipped in hot water, or with a hempen mop, and soapsuds, or, if the patient be feeble, with bran and soapsuds. By these various expedients the skin is not only cleansed, but so strongly excited, also, that it burns, and smarts, and glows, and thus a powerful revulsive action from internal organs is established, which is found to be advantageous in many diseases. The affusion with cold water, at different temperatures, is sometimes repeated several times, and has the effect of cooling the skin, and promoting the perspiration, while so powerful is the tendency of the blood to the surface that there is little danger of taking cold or of any internal congestions forming. But the contact of the cold must be abrupt and very brief, if these dangers are to be avoided. Indeed, the excessive stimulation of the skin which characterizes the "Russian bath" would be wholly counteracted by a prolonged application of cold, and an equally exaggerated susceptibility to cold would result. The cold shock is applied in the form of the shower or douche, or less frequently, the plunge-bath. The Russian populace, however,

leap into a tank, or the river, or roll themselves in the snow; but they return immediately to the hot steam-chamber.

The duration of the Russian vapor bath is at first generally fifteen minutes, but after frequent repetition it is prolonged to half an hour or even an hour. The management of the bather on leaving the bath is the same as already described for the ordinary vapor bath.

In general, the effect of this bath is at first disagreeable, and leaves the patient fatigued and relaxed, but he soon becomes accustomed to it, and enjoys a sense of peculiar lightness and vigor. The secretions are augmented for a time, and in some cases perspiration continues for twenty-four hours. Its action upon the skin may be inferred from the fact that it very sensibly diminishes the weight of the body. Wiegand found that during half an hour passed in the hot vapor bath the loss by perspiration was 7 ounces and 2 drachms, and that subsequently, in the antechamber, a further loss of 8 ounces and 6 drachms was sustained. But as this loss is of liquid, it is speedily repaired, and it is found among the Russians that the habitual use of the bath neither enfeebles the system nor diminishes the weight. Sometimes a pustular or other eruption of the skin ensues, which would appear either to show that some morbid material contained in the blood is eliminated through this passage, or else that the heat and friction of the skin are powerfully irritating.

The general vapor bath should seldom be used, or only with great circumspection in cases of organic disease, particularly of the lungs and heart, whenever the debility of the patient is great, or when, on the other hand, there exists a plethoric state, or an apoplectic tendency.

Other forms of vapor bath are in use, such as wooden closets into which steam is admitted from below, and in the door of which an opening is provided through which the patient may pass his head while the rest of the body is exposed to the heat within. Or, the patient being seated, a large blanket is fastened around his neck, reaching the ground, while beneath it a tube connected with a small boiler surrounds him with an atmosphere of vapor. Or a similar tube may be introduced beneath the patient's bedclothes, raised from his body by means of hoops. Similar arrangements may be made for applying steam locally, as to one limb, or a portion of the trunk. The vapor of slaking lime has sometimes been used instead of watery vapor generated by fire. It is conveniently applied under a blanket while the patient sits in a chair or lies on his bed. In cases of *amenorrhœa*, *dysmenorrhœa*, *spasmodic retention of urine*, *painful hæmorrhoids*, etc., the patient may sit upon a night-stool over a metallic vessel in which water is kept at a proper temperature by means of a spirit-lamp placed underneath it. Watery vapor at the ordinary temperature of the air is sometimes diffused through the atmosphere of the sick-room, or employed by means of a small boiler, both for its own sake, as being less irritating than

dry air, and as a means of conveying narcotic and other medicines to the lungs.

Uses of the Vapor Bath.—The last-mentioned method of applying warm watery vapor is of especial utility in allaying irritation and spasm of the larynx in *croup*, and other forms of laryngeal inflammation whether acute or chronic.

In acute muscular *rheumatism*, soon after its commencement, nothing is more effectual than the vapor-bath in cutting short the attack. Generally, however, internal diaphoretics are found to be more convenient. In chronic articular *rheumatism* and *gout*, the vapor-bath alone, or accompanied with frictions and the cold or hot douche, has been found very efficient in removing the pain, stiffness, and swelling of the affected parts. But it must be admitted that its operation is very slow, and seldom curative by itself. In peripheral *paralysis*, or in the centric forms in which the lesion has been as far as possible repaired, the vapor-bath, like other external stimulants, is useful in restoring muscular nutrition, reviving the nervous energy, and, in case of muscular contraction, diminishing the stiffness. *Anasarca* following scarlatina or suppression of the perspiration is much benefited by this remedy; so too is *scrofula*, when it affects the glands and other superficial parts, particularly in cases remarkable for a harsh and dry condition of the skin. The warm vapor-bath has been used in cases of an imperfect or tardy eruption or its retrocession in *exanthematous fevers*. In all chronic *cutaneous diseases*, when the skin is torpid, hard, and dry, or is covered with accumulations of crusts or epidermic scales, it cleanses the integument and renews its vitality. The hot steam bath, followed by cold affusions, is said to be curative of *profuse sweating* independent of organic disease.

Of Warm and Hot Water.

Action.—As the capacity of water for caloric is three thousand times greater than that of air, the former is capable of producing the phenomena of heat much more energetically than the latter. At the same temperature water *feels* hotter than air or watery vapor; or, to express the difference more accurately, water at 112° F. acts as a healing agent more powerfully than watery vapor at 140° or 160° F.

The phenomena produced by the *internal* administration of warm water vary with its temperature. When it is warmer than the stomach (98° to 113° F.), it excites a sense of gentle warmth in this organ, which also diffuses itself more or less over the whole body, and slightly augments the force and frequency of the pulse. The warmth of the liquid promotes its diluent operation, and augments especially the secretions of the skin and the kidneys. Its directly heating and indirectly stimulating action is resorted to when the temperature of the body is unduly depressed, or when an internal sensation of cold is experienced. Generally it is administered in the form of an infusion of some aromatic plant, or with some alco-

holic liquor, and at the temperature above mentioned. To obtain its stimulant effects, a higher degree of heat (120° to 140° F.) is required; but many persons are unable to swallow water as warm as this. It should, however, be remembered that the stomach is less impressionable than the mouth. It also retains hot much better than lukewarm water, which, indeed, is proverbially a nauseating liquid. After a copious draught of hot water the circulation is decidedly quickened, as well as the secretions of the kidneys and the skin. The habitual use of hot water as a drink entails debility of the stomach and dyspepsia; but these effects are in some degree mitigated by the addition of aromatic or alcoholic stimulants to the draught.

The *external* action of warm water is best exhibited in the *warm bath.* In the general warm bath it is to be observed that the cutaneous exhalation is arrested, and hence that there is no loss of caloric by the skin. On the other hand, as the body gains slightly in weight during the bath, an imbibition or absorption of water must have taken place, although not in a sufficient quantity to modify the circulating fluids materially. The changes brought about result chiefly from the action upon the skin and from the absorption of caloric. The experiments of Mosler on protracted *hot baths*[1] prove that they occasion a decided diminution of weight. In the course of an hour from one to two pounds may be lost by exhalation from the skin and lungs. The temperature of the atmosphere at the same time modifies the result. When the water was at 108°, the external air at 80°, and that of the bath-room at 77°, the loss of weight equalled 975 grammes in an hour; but when the external temperature was 68° and that of the bath-room 66°, the loss of weight in the same time was only 930 grammes, although the temperature of the water was 111°. For practical purposes a higher temperature than 100° to 105° F. is seldom required; and even such a bath, if suddenly entered, will be very apt to occasion distress by arresting the exhalation from the surface of the body immersed in the water. The blood tends to those parts in immediate contact with the external air, and the bather experiences more or less discomfort in the head and chest, at least until a copious perspiration breaks out upon the face, which affords almost immediate relief. Hence the temperature of a warm-bath should at first seldom exceed 100° F., and after a few minutes it may gradually be raised to 105°.

Lukewarm or *tepid* water (85° to 95° F.) is most generally used for bathing. The lower temperature mentioned usually excites a sense of chilliness, and is therefore unsuitable for sensitive persons. Tepid baths are chiefly used for purposes of cleanliness. They do not excite much, if any, perspiration. *Warm* water is most usually employed as a bath, at about 106° F., for at a higher temperature the bath is apt to prove exciting; the sensation is rather burning, the skin becomes red, the pulse and respiration quick, and the head

[1] Virchow's Archiv, xiv. 565.

somewhat full. Sweating follows the bath, and is copious when it is encouraged by warm bedclothing, and especially by blankets next to the skin. During this operation there is generally a strong inclination to sleep.

The *local* action of water at a temperature of 98° to 106° F. consists in an increase of heat, relaxation of the tissues, and disturbance of the function of the part. The *increased temperature* depends upon the accession of caloric, on the one hand, and upon its impeded escape, upon the other. Relaxation of tissue or diminished contractility is seen when the hand or foot, for example, is held for some time in warm water; the part grows more and more swollen, the veins more prominent, and the skin softer. Hence in bleeding from the hand or foot the flow of blood is promoted by immersing the part in warm water. In like manner poultices and warm fomentations are used to favor the bleeding of leech-bites, scarifications, etc. From its *relaxing properties* water constitutes the best means of cleansing the skin, which it does by removing the impurities contracted from without as well as the detritus of the epidermis, and the oily and saline secretions of the cutis. When thus cleansed, the skin absorbs more actively, a fact that should not be overlooked in the application of mercurial inunctions, cantharides, or mustard plasters, etc. The afflux of blood alluded to produces a quickening of the vital processes of the part, and promotes the removal of congestions, exudations, and deposits. When a large portion of the body is subjected to this stimulus, the blood is drawn away from the internal organs, and morbid accumulations of it are prevented. The *alteration of function* in the part to which warm water is applied involves its sensibility, motility, and secernent power. In the experiment to which allusion was just now made, the swollen hand feels stiff and heavy, and its sense of touch is blunted, but in other respects its sensibility is more acute, and that in proportion as the water used has been hotter. The muscular power of a part long immersed in warm water is impaired; this is manifest in the general muscular relaxation produced by the warm bath, and which is practically induced by physicians in the treatment of luxations, of strangulated hernia, of intestinal spasm, or spasm of the gall-duct, ureter, urethra, etc. Nasse's experiments prove that the temperature of a bath strikingly influences the secretion of urine. At 93° or 97° this secretion is less than when the temperature is between 92° and 96°.[1] In either case the influence is only temporary. Certain secondary effects of warm bathing may be noticed. As the congestion and tumefaction of superficial parts subside, perspiration breaks out, and may become very copious if it is favored by the patient's being kept at rest in bed. Indeed, it is a very powerful sudorific, and constitutes one of the most salutary measures which can be employed on a great variety of occasions, but particularly at the commencement of febrile diseases. In advanced stages, also, of continued fever

[1] Arch. f. wiss. Heilk., ii. 273.

when the skin grows dry, and the mouth foul, and the intelligence is becoming overcast, tepid baths are sometimes of singular efficacy in restoring suppleness to the skin, in clearing the mind, and sometimes in producing a critical sweat.

Water, and also watery vapor, at a high temperature (boiling water and steam) produce a different class of symptoms, those of *scalding*. When they act upon the skin, acute pain with redness is produced, followed by vesication, and in extreme cases by a destruction of the vitality of the part. If, when, by means of warm water applied for some time, the body becomes heated much beyond its normal temperature, cold water is used in the form of the douche or plunge-bath, a copious perspiration ensues, provided the cold act but momentarily; for, if its action be prolonged, a chill may occur with congestion of the lungs, brain, or bowels, or else an attack of rheumatism. Or, if, instead of the whole surface being thus exposed to cold, a portion of it only is subjected to the action of a draught of air, some more local derangement, such as ophthalmia, otitis, otalgia, rheumatism of several associated muscles, etc., may result.

Special Uses of Warm and Hot Baths.—The tepid bath (85° to 95° F.) is among the most important of hygienic measures. It should be used from fifteen to thirty minutes at least, and repeated every week or oftener, according to the condition of the skin and the general effects which it produces. At a temperature of 100° to 110°, the bath manifests a *stimulant* power in cases of exhaustion after great muscular fatigue, in apparent death from intoxication, from suffocation, or from strangulation by hanging, or, in the case of the new-born child, by the pressure of the umbilical cord, provided there be no evidence of active congestion of the brain, but, on the other hand, a cool and flaccid condition of the system denoting exhaustion. Chronic *diseases of the skin*, and particularly the scaly forms, are nearly always benefited by the use of prolonged warm baths (at 96° to 100° F.), which remove the thickened epidermis and crusts, soften the tissue of the cutis, and stimulate the cutaneous circulation and secretions. Above the temperature indicated, there is danger lest the morbid activity of the integument should be aggravated. Much, however, will depend upon the duration of the disease and the sensibility of the skin. In *chronic rheumatism* and *gout*, warm bathing is decidedly efficacious, and sometimes curative. The higher temperatures are here the best. Among the important applications of the warm bath is its use in *Bright's disease* of the kidney. It is of course more efficacious in the desquamative than in the interstitial form of this affection, and in acute more than in chronic cases. It acts chiefly by relieving the kidneys for a time from their congested state. It is probably less efficient than the hot-air bath. In *diabetes* it is well known that among the most powerful palliatives of the disease are to be reckoned the thermal waters of Carlsbad and of Vichy; and although their utility is apt to be ascribed solely to the alkaline ingredients of these springs, we entertain no doubt that it is also largely due to their effects in baths upon the skin, by which the

dry, harsh, and inactive state of that integument is more or less restored to its natural condition, and internal organs are in the same degree relieved. In *paralysis*, and particularly *paraplegia*, this remedy is often successful; but the general bath alone is less so than when it is conjoined with the warm douche. This latter is also peculiarly valuable in rheumatic and arthritic affections, and in sciatica. Dr. Léséleuc, of Brest, has reported three cases of *traumatic tetanus* whose cure appears fairly to be attributed to daily warm baths of from two to three hours each. The water was maintained at a temperature between 97° and 100° F., and each patient was immersed in it daily for a period varying from half an hour to three or four hours. One of the patients had thirteen, another fourteen, and the third twenty-nine baths before convalescence was fully established.[1] The soothing influence of the warm bath is pre-eminently useful in the treatment of almost every form of *mental derangement*, from mania to melancholia. It is essential in the treatment of *infantile convulsions*. Its revulsive and anodyne qualities are exhibited in the various forms of painful visceral disease already referred to, and in derangements of the gastro-intestinal canal and its subsidiary organs, particularly in those which are attended with frequent vomiting or purging. The efficacy of this remedy in the *summer complaint* of our climate (*cholera infantum*) can hardly be over-estimated. Several chronic diseases have already been mentioned in which warm bathing exercises a favorable influence; to these may be added *scrofula*, *chlorosis*, *constitutional syphilis*, and whatever other disease depends upon a morbid element generated within the body or received from without. In fact warm bathing, like cold bathing, like hydro-therapy, like gymnastic exercise, and various other means, merely tends to promote and quicken the organic movements appertaining to nutrition, to replace the old and exhausted by new and vigorous molecules, and the unsound by the sound, thereby restoring the body as nearly as possible to its pristine vigor and its functions to their normal operation.

Partial Warm Baths.—The *footbath* is one of the most useful of partial warm baths. Its object generally is to draw away the blood from the upper part of the body, and thus relieve the brain, lungs, or other organs in which pain is felt, or congestion has taken place. If its temperature does not exceed 100° F. it excites an agreeable perspiration, and disposes to sleep. But at a higher temperature (108° to 112°) it acts as a direct excitant, heats the whole body, quickens the pulse, and renders the sleep restless and unrefreshing, or even prevents it altogether. The pediluvium may be rendered more active by the addition of salt or mustard, which is equivalent in effect to several degrees of heat. The water should rise as high as the calves of the legs; the lower limbs should be surrounded by a blanket, including also the foot-tub, and the bath should last from fifteen to thirty minutes.

This remedy is of great service at the commencement of *headache*,

[1] Bull. de Thérap., lxvi. 458.

sore-throat, *coryza*, *pulmonary catarrh*, etc., and is one of the most powerful means of bringing on the *catamenia*, when they are delayed by cold or similar transient causes, and also as an adjuvant to other emmenagogue medicines. It is also of great value as a revulsive in *spasmodic croup*, and although less so in *pure laryngitis* and *membranous croup*, it ought not to be omitted in these, or, indeed, in the early stage of any inflammatory disease.

The *hipbath* consists of any convenient vessel containing warm water (at 98° to 100° F.), in which the patient can sit so that the pelvis shall be covered by the liquid. Its operation is analogous to that of the footbath, but it is especially appropriate for the relief of disorders of the pelvic viscera. It is used to relieve *gravel*, *strangury*, *retention of urine*, and *uterine colic*, to promote the *catamenial flow*, and also the *hæmorrhoidal* discharge.

Fomentations with warm water, by means of cloths, sponges, spongio-piline, poultices, etc., may be classed as local warm baths, and are in common use to relieve the tension of the skin produced by inflammation, abscesses, etc., and thus at once to moderate the morbid process, and assuage pain. They are often preferable to bread and milk, flaxseed meal, and other farinaceous cataplasms, which, by acidifying, tend to make the skin sore, and produce desquamation of the cuticle. Warm fomentations to the mammæ have decided *galactagogue* virtues, and are used as a domestic remedy to promote the flow of milk. By means of the sympathy between the mammæ and the uterus, such applications to the former, particularly when quickened by stimulant embrocations, or by suction of the nipple, have frequently been effectual in restoring the suspended *menstrual flow*.

Injections of warm water into the *vagina* are employed for the purpose of recalling suppressed *lochia* or *catamenia*, and to alleviate pain in the pelvic viscera. Clysters of the same are also used to evacuate the bowels.

Warm sand-baths are used in some places where thermal mineral waters exist. The patient, in a sitting position, is buried to his neck in sand, mud, or gravel, saturated with the warm water. Gout, rheumatism, general dropsy, etc., have been treated by this means. A similar method is sometimes used at the sea-shore in midsummer.

Boiling water acts like a cautery, and is a powerful revulsive which may be resorted to in extreme cases when it is necessary to produce an immediate and powerful revulsion or stimulation. This is particularly the case in *asphyxia* and in *prolonged syncope*, when the electro-magnetic apparatus is not at hand. But it should be used with extreme circumspection.

Hot water, at as high a temperature as can be borne without its scalding, has been successfully employed to arrest the development of *panaris*, and also of *frost-bite*. Its stimulant action upon the capillaries is also illustrated by the control which it exercises over *colliquative perspiration* in exhausted conditions of the system, and by its power of arresting *hemorrhage* from leech-bites and from alveolar cavities from which teeth have been extracted.

ELECTRICITY.

Definition.—Electricity is an imponderable agent which appears to reside in all bodies. Its name is derived from ἤλεκτρον (amber), for it was first observed by Thales, of Miletus, to be developed by friction of that substance.

History.—No distinct trace of an acquaintance with the properties of electricity can be discovered until the time of Paracelsus, who attributed curative virtues to the loadstone. Little, however, was added to the vague notions entertained by this philosopher until the invention of the artificial magnet by Max. Hell, of Vienna, about the middle of the eighteenth century, and that of the electrical machine shortly afterwards. Jallabert (1748) was the first to apply the latter instrument successfully for the treatment of paralysis. Soon afterwards Franklin used it for the same purpose, but without permanent advantage. From that date numerous publications appeared, recounting cures by means of the electric bath, sparks, and shocks. In 1780 Cavallo published his essay on the Theory and Practice of Medical Electricity, showing its utility in paralysis, chronic rheumatism, chorea, epilepsy, apparent death, etc.; and in France, Poma and Arnaud gave a similar account of its effects in 1787. Two years later, Galvani made the discovery which has immortalized his name. So much more decided were the effects produced by voltaic and galvanic instruments than had been obtained from mechanical electricity, that the latter fell into comparative neglect. The new agents would, in all probability, have sooner reached the position they have since occupied, had they not formed such ready tools for charlatanism, and thus shared in the aversion inspired by their seeming alliance with the mummeries and impostures of "animal magnetism." But as the progress of science continued to develop more and more the essential part played by electricity in all vital as well as merely physical phenomena, the attention of eminent physicians became more strongly fixed upon its therapeutical powers, whose reality, as demonstrated by the galvanic apparatus, could no longer be questioned. But it is chiefly to the discovery of induced galvanic electricity by Faraday, and the invention of the rotary magneto-electric apparatus of Pixii (1832), that we owe the considerable advances that have recently been made in this department of therapeutics. The most eminent physicians of Europe have contributed either to the improvement of the electrical apparatus, or to enlarge the list of diseases which it is able to relieve or cure.

Sources and Properties.—It is now certain that any disturbance in the molecular condition of bodies may give rise to electrical phenomena. Friction is one of the most common and the longest known of the causes which develop them; but chemical agencies, and the natural magnetic properties of certain substances, are those most frequently employed for medical purposes. The friction of sealing-wax, sulphur, glass, gutta-percha, etc., by means

of a silken, woollen, or leather substance, causes them to attract and repel alternately light bodies, such as down, feathers, pith, etc.; but the metals, charcoal, vegetable matter, and all moist substances, are incapable of being so excited unless they are insulated —that is, unless their connection with the earth is cut off. Thus all bodies may be arranged in two classes, conductors and non-conductors of electricity. Although the former, except when insulated, never display electrical powers developed by friction, yet they constitute the chief sources of electricity developed by chemical action, or galvanism.

It has long been a question among natural philosophers whether the phenomena of electricity are due to a single fluid or to two fluids, tending constantly to neutralize each other. But these phenomena are explicable on either supposition. If two pith-balls, suspended by means of silken threads, in contact with each other, are touched by sealing-wax, glass, or other electric, excited by friction, mutual repulsion between them will take place; but if one ball be touched by excited sealing-wax, and the other by excited glass, the two balls will tend towards each other. This phenomenon was early observed, and led to a belief that sealing-wax generated one kind of electricity, and glass another, which were called respectively resinous and vitreous. But the phenomena described, and, indeed, all which the different forms of electricity present, are explicable upon the simpler theory of a single electrical fluid. This theory originated with Franklin. He supposed that electricity, as a subtle elastic fluid, pervades all nature, but gives no indication of its presence during the repose of matter. Any disturbance, however, of the natural molecular condition of inorganic or organic matter evolves electricity, which then tends to accumulate in some bodies, while it is relatively deficient in others. In the former case it is called positive; and in the latter, negative electricity. As the particles of this fluid are mutually repellent, atoms or bodies equally charged with it tend to separate one from another; and when of sufficiently light material, as in the case of the pith-balls, they actually do so. On the other hand, when it exists in excess in some bodies, and is deficient in others, there is a tendency to the restoration of an electrical equilibrium, and, as in the case of the pith-balls, attraction is manifested; the electric excess on the one side supplies the deficiency on the other, and the balance is restored. In this theory, positive corresponds to vitreous, and negative to resinous electricity, in the theory of the two fluids.

Some of the fundamental laws which govern the operations of electricity may be stated as follows: the mutual attraction and repulsion of electrified bodies for one another are in an inverse ratio to the square of the distance between them. Their reaction upon one another is in a compound ratio of the quantity of electricity they possess. The mutual repulsion of electrical atoms for one another causes the fluid to reside on the surface of all bodies in which it exists. Hence, if a metallic sphere be electrified, all portions of its surface will possess the same amount of fluid; but if

the sphere be flattened, more electricity will exist at the equator than at the poles. On the other hand, if it be elongated into a cylinder, the two ends of it will be most abundantly supplied; or, if one of these be drawn out to a point, all of the electricity will tend to escape by the latter. In like manner, if a cylinder charged with electricity be furnished with a row of metallic points at one extremity, a constant stream issues from them, and in the dark appears as luminous pencils of divergent rays. When two bodies charged with opposite electricities, or in opposite electrical states, are brought near together, a tendency exists to the restoration of electrical equilibrium, and when this is effected, a spark or flash takes place with a sharp report if the quantity of electricity is large. This phenomenon is an exact imitation, on a small scale, of lightning and thunder, as was fully demonstrated by the famous experiment of Franklin with his kite. The clouds and the earth being in opposite electrical states, equilibrium between them is restored with explosive violence.

Owing to the mutual repulsion of electrical particles of the same name, when electricity is accumulated in a body, it *induces* an opposite condition in neighboring bodies. It drives their electricity from the adjacent surfaces, so that these assume a negatively electric condition; or, if the electricity is withdrawn from a body, it *induces* an overcharged state of the neighboring bodies. The influence or power by which this change is effected is called *induction*, and a distinct idea of it is essential to the comprehension of nearly all electrical apparatus and phenomena. The most familiar example of induction is the Leyden jar. A glass jar is coated within and without to two-thirds of its height with tin foil, and the internal coating is connected with an electrical machine, or other generator of electricity, while the external coating communicates with the ground. In proportion as the electricity accumulates on the internal coating, and becomes positive, the external coating loses its natural electricity, and becomes negative. If now the two be connected by means of a metallic or other good conductor, the equilibrium of the electric fluid is instantaneously restored, with the phenomena of light (in the shape of a flash or spark), heat, sound, and commotion; those, in fact, of lightning. If the connection between the inner and outer coatings be made partly by certain bodies, the electricity will pass through them, piercing, rending, or inflaming them, according to their nature. Cotton dusted with powdered rosin, or wet with alcohol or ether, may be inflamed; water decomposed, or its elements united; metallic wires and other solid bodies heated, melted, or even vaporized; or, if the discharge takes place through the living body, as by placing the hands in connection with the interior and exterior respectively of the Leyden jar, or between the opposite poles of galvanic or electric batteries, a shock is felt, especially at the joints, and the muscles are contracted spasmodically.

Varieties and Properties of Electricity.—The varieties of electricity depend upon its mode of development, according as this

is by *friction* or mechanical action, by *contact* or chemical action, or by *induction* from these sources or from magnetism.

Mechanical, Franklinic, or Static Electricity.—This is usually generated by the so-called electrical machine, in which a glass plate or cylinder is made to revolve under the friction of leather cushions covered with an amalgam of mercury, zinc, and tin. The evolved electricity is drawn into an isolated metallic conductor by means of sharp points of metal. From this it may be received in the Leyden jar, or any other insulated receptacle; the human body, for instance, placed upon a stool with glass feet. Such electricity is comparatively small in quantity, but highly concentrated, and is hence said to possess a high degree of *intensity*, or to have a great power of overcoming resistance to its progress. It readily produces the disruption of bodies which it traverses, but influences their chemical or atomic composition in a much less degree. In this respect it contrasts strongly with the fluid generated by electro-chemical arrangements. These produce electricity of a low degree of *intensity* but in large *quantity* and of wonderful decomposing energy. Thus the most powerful electrical machine is scarcely competent to decompose a drop of water, while the elements of this fluid are readily separated by galvanic or magnetic electricity.

Nearly a century ago Volta invented the Electrophorus; it consists of a metallic frame filled with a mixture of which the principal ingredient is shellac, and moulded so as to present a flat surface, level with the edge of the frame; there is also a metallic cover provided with an insulated handle. The surface is excited by beating it with a cat skin, then the cover is applied and withdrawn, producing by *induction* a current of positive electricity: sparks an inch long may be thus obtained, and even small Leyden jars can be charged, but the quantity is too small to be of much therapeutic value. Recently, Holtz, of Berlin, has perfected his *Electrophorus Machine*, which produces electricity of remarkable tension, giving sparks of ten, twelve, and even more inches in length. The current furnished by this machine, like that produced by Volta's electrophorus, is the result of inductive action, instead of being developed by friction, but in all other respects is identical with frictional electricity. In the remedial employment of static currents, this instrument will take the place of the friction machines. In consequence of the severity of the transmission of the sparks to the body, only the smallest size of the Holtz machine is suited for therapeutic purposes. Static electricity has been and is still employed as a stimulant to sensory nerves, as a counter-irritant, to induce perspiration, increase temperature, and in the treatment of amenorrhœa, paralysis, etc.

Application.—The forms under which mechanical electricity is used are the *bath*, the *aura*, the *spark*, and the *shock*.

The *electric bath* consists simply in placing the patient upon an insulating stool connected with the prime conductor, thus giving him an electro-positive bath. His whole body is charged with

electricity. The hairs of his head become mutually repellent and stand on end; from his eyelashes, the tips of his fingers and nose, and from other prominent parts, an aura issues which is luminous in the dark. In some cases the circulation is quickened; the secretions generally become more active, and perspiration breaks out.[1] But these phenomena very probably depend upon the patient's agitation, for Giacomini has related that, according to his observations, neither the pulse, the secretions, the respiration, nor the mental condition undergo any change.[2]

It is affirmed by the author just named that, when an insulated person is connected with the rubber of the electrical machine while the conductor communicates with the ground (electro-negative bath), he is exhausted of his electricity, and so marked a sedative effect is produced upon his system that inflamed portions of his skin grow pale, and headaches and neuralgic pains are dissipated by this electrical depletion. These assertions, so readily susceptible of confirmation, if correct, have not been supported by other writers, and very certainly no analogous phenomena are observed in healthy persons under the conditions named.

The electric *aura* is produced by the action of a pointed conductor either of brass or wood. By attaching this body to the prime conductor by means of a chain, and connecting at the same time the patient's body with the rubber of the machine, a pencil of electric rays is projected from the point against whatever part of the integument it is desired to act upon. In this manner he receives positive electricity. On the other hand, if he is placed on the insulating stool in connection with the prime conductor, and the points are moved near the surface of the skin, positive electricity is withdrawn from him. Finally, if, while insulated, points connected with the rubber are presented to his body, his electricity is withdrawn by them.

The *spark* is obtained for medicinal purposes by insulating the patient, in connection with the prime conductor, and bringing a blunt metallic body near the affected part. Sparks pass from the latter to the former, occasioning a stinging, pricking, or tearing sensation, according to the intensity of the discharge. A small, circumscribed wheal, surrounded by a little inflammatory blush, is produced in delicate skins. In certain diseases (paralysis, rheumatism), Cavallo drew sparks by means of a metallic ball through flannel applied over the affected part in one or several folds, according to the power of the machine employed.

The *shock* is produced by including a portion of the body in the circuit formed when a Leyden jar or battery is discharged. For example: if a chain communicating with the outer coating of the jar is held in one hand, while the other touches the knob of the jar, a discharge will take place through the arms and chest. It produces a disagreeable spasmodic jerking, accompanied by a sense

[1] G. Bird, Guy's Hosp. Rep., No. xii. p. 85.
[2] Bibliothèque du Médecin practicien, xiv. 90.

of contusion, which pervades the parts traversed by the charge, or, when the charge is a feeble one, only in the parts nearest the jar. If a discharge is made through a nervous trunk, a severe contusive pain is experienced, followed by a numbness of the part. The discharge of an electrical battery or assemblage of Leyden jars, may kill small animals, dogs, and even men. The parts attacked by the electricity are injured in the same way as by lightning, and exhibit signs of burning, wheals, or punctures, and the limbs are usually relaxed. No internal lesion is discovered after death, except that the blood is not coagulated. Several cases are recorded in which hemiplegia of long duration appears to have been the effect of electric shocks,[1] an occurrence which has been attributed to the formation of a clot (embolus), and its conveyance to the brain by the arteries.

These modes of electrization are quite superseded by galvanic and voltaic electricity.

Galvanic or voltaic electricity is developed by the contact and chemical action of dissimilar substances. Hence it is sometimes described as *contact electricity*. In 1789, Galvani, of Bologna, discovered, in some experiments upon frogs, that when a nerve and muscle were joined by a metallic medium, muscular contraction was excited. He at first supposed the cause of this movement to be the nervous force, but Volta proved it to be electricity excited by the contact of the substances mentioned, and that the contraction was still more decided when dissimilar metals were used, as, for example, zinc and copper. It is now certain that chemical action is the source of the electricity in the above experiment, and that of the two metals employed, the zinc is the one chiefly attacked, and that the copper is the recipient or condenser of the electricity developed.

Several metals, such as lead, iron, tin, bismuth, and antimony, have the same reaction as zinc, and hence are called electro-positive; while others react like copper, as, for example, gold, silver, and platinum, and hence are called electro-negative. This mode of developing electricity is now become familiar in the galvanic battery. In its simplest form it consists of a single pair of plates, *i. e.*, of a copper and zinc plate, placed perpendicularly and apart in a glass vessel containing slightly acidulated water. While they remain unconnected, no phenomena are noticed, but if they are connected above by means of a copper wire, the oxygen of the water immediately attacks the zinc, hydrogen gas escapes in bubbles, and the electricity which is developed accumulates on the copper plate, or rather a circulation is established from the zinc to the copper, through the water, and from the copper through the wire back to the zinc. The most oxidizable metal of the two employed, is that which furnishes the supply of electricity; hence in the arrangement of plates just described, the zinc is the positive pole, parting with its current, which is attracted, through the fluid, by the copper or

[1] Lancet, July, 1861, p. 86; Sept. 1861, p. 253.

negative pole. But this relation of polarity is only applicable to that portion of the plates which is immersed in the liquid—out of which, the copper becomes the positive, and in turn parts with its electricity, which is received through the conducting wire, by the unimmersed or negative portion of the zinc; consequently, in connecting such a battery with an electro-magnetic or other instrument, the copper plate should be connected with the positive pole of the instrument, and the zinc plate with the negative. When the wire which completes the circuit between the plates is divided at any point, the passage of electricity between its two extremities occasions various phenomena, accompanied by light, heat, and chemical effects.

The *Smee* battery is the form of cell generally used when but one or two are required, as in running the electro-magnetic machine. It is composed of an insulated silver plate, generally corrugated to increase the surface exposed, and clamped between two plates of zinc; these are immersed in a solution of about one part of sulphuric acid to sixteen or twenty of water. As soon as contact is made between the poles, chemical action takes place and the water is decomposed; the free oxygen attacks the zinc forming its oxide, with which the sulphuric acid unites to make sulphate of zinc, while the nascent hydrogen passes over to the silver and accumulates on its surface. In a little while the violent action which first occurred on making contact decreases, while the electricity evolved is reduced to almost nothing in consequence of a condition termed *polarization.* We have seen that during the passage of the current through the liquid of the battery, the immersed end of the zinc is the positive pole, to which is attracted the liberated oxygen, an electro-negative; while to the immersed end of the silver is attracted the hydrogen, an electro-positive. In this condition the gases act precisely as if they were metals, and while the original current is passing from the zinc to the silver, the new element, hydrogen, acting like the positive zinc, sends its counter current to the negative oxygen; thus, in time, practically reducing the action of the battery, as if it were composed of two similar metals. To overcome this objection, and keep up a regular supply of electricity, some means must be devised to constantly remove the film of hydrogen from the silver plate, or prevent its accumulation there. In the Smee battery an attempt is made to accomplish this mechanically. The plate of silver is so treated as to prevent the adhesion of the hydrogen by first granulating its surface, and then depositing on it, by either the chemical or plating process, a black powder of platinum. The zincs are prepared by thoroughly amalgamating them. This battery gives a very good continuous, but not a constant current; while the circuit is open there is little or no action, and the battery may remain thus for weeks without replenishing, ready for work at a moment's notice. If used constantly, the liquid soon becomes saturated with sulphate of zinc, and should be replaced with a fresh solution. In nearly all other forms of battery, polarization is lessened or prevented by the use of

two exciting liquids, separated by a porous division or cup; the object is to effect a combination with, and thus remove the evolved hydrogen. Such an arrangement constitutes the *constant* batteries. The first of the kind was constructed by Becquerel, who used a bladder for the porous diaphragm. The *Daniell* battery is an improvement on this form in the substitution of a porous earthen cup for the bladder, and consists of a glass jar containing a slightly acidulated water, in which is immersed a zinc cylinder; within this is the porous cup, containing a rod or sheet of copper in a saturated solution of sulphate of copper. When this cell is in action both liquids are decomposed, part of the oxygen combining with the hydrogen to form water, and another part to unite with the zinc, forming its oxide, which is then combined with the sulphuric acid. The liberated copper is attracted to the copper rod in irregular granulations, and, if allowed to come in contact with the porous cup, will permeate its structure, and occasionally burst it. Amalgamating the zincs prevents local action where the battery is not in use, and enables it to be worked longer. The advantage of the Daniell battery, or other similar modification, is its constancy of action, maintaining an almost uniform flow of galvanism. It is also a *continuous* battery, running for months, and needing only the addition of a little sulphate of copper. Compared with many other forms, it gives a current of small quantity and intensity. Another and perhaps a better form of constant cell is the *Callaud*, in which the porous cup is dispensed with, the separation of the liquids depending on the gravitation of the heavier solution. It consists of a large glass jar, on the bottom of which is placed a disk of copper, with an insulated connecting wire running to the top. Suspended four or five inches above the disk is a cylinder or plate of zinc; a layer of sulphate of copper is placed on the bottom, and water is then added until the zinc is covered. In a short time the blue solution extends half way up, and the cell is ready for use. The same action takes place as described in the Daniell cell, and it gives nearly the same quantity and intensity.

By *quantity* is meant the amount of electricity developed in a cell, and which is in proportion to the area of metallic surface exposed to chemical action. If we arrange a number of cells in a series, so that the positive pole of one shall be connected with the negative pole of another, we do not augment the quantity; the same action takes place in each cell that occurred in the first, the effect of which is to urge forward the current to overcome the resistance which each additional cell has interposed, thus producing a quality which is expressed as *intensity*.

The *Grove* battery is different from the Daniell, in having platinum for the negative metal, which is immersed in nitric acid, contained in the earthen cup, outside of which is the zinc cylinder, surrounded by dilute sulphuric acid. This battery is remarkable for its intensity and quantity, but is objectionable on account of the nitrous acid fumes evolved during its action. An excellent arrangement of equally good action is the *Bunsen* battery, in which

a carbon plate is substituted for the platinum, and, instead of nitric acid, a solution of bichromate of potash in dilute sulphuric acid; otherwise it is similar to the Grove, but is devoid of its objection, as no fumes are given off. A similar arrangement, without the porous cup, and known as the *Grenet* cell, is a very convenient form for office use, where a single cell is needed. The glass vessel is bottle-shaped, with a wide mouth, to which is fitted a metallic cup, and to which a pair of carbons are permanently attached. When not in use the zinc is withdrawn from the solution by a rod, which permits a change in the current in proportion to the immersion of the zinc in the exciting fluid. It is clean and portable, and may be used with advantage instead of the Smee cell.

When a number of cells, such as have been described, are arranged in a regular series, and the circuit from the extreme pole is opened and closed, phenomena are developed of the same kind as, but of much greater activity than, in the case of a single pair. These phenomena are mainly chemical and calorific, as distinguished from those of the electrical machine, which are chiefly mechanical; the alkalies, for example, were proved by this agency to be compounds of a metallic base with an electro-negative body. When the poles of a battery terminate in charcoal points, and these are brought very near to one another, a more brilliant light is produced than by any other means.

Galvanic induction, like induction from mechanical electricity, may be produced in the following manner: If a wire in its natural state is placed parallel with another which is traversed by a current of galvanism, a change in the electrical condition of the former takes place; a current is established within it which has a direction opposite to that of the primary current; and if the two wires be brought very closely together a spark will pass between them.

Magnetic and Induction Electricity. Faradism.—The ancients were acquainted with the power of the *loadstone* to attract iron. This mineral, an oxide of iron, was called by the Greeks μαγνης, and from this word magnet is derived. The *polarity* of the magnet, or the directive power by which it tends to assume a north and south direction, was unknown in Europe until the twelfth century, when a knowledge of the mariner's compass, derived from the Chinese through the Tartars, was brought from the East by the Crusaders.[1] The general phenomena of magnetism and electricity are very analogous; thus similar and dissimilar ends, or poles, of magnets mutually repel and attract; bodies are rendered magnetic by *induction*, and the sensible distribution of magnetism, like that of electricity, is superficial. But magnetism is incapable of *transference*, since a magnet becomes stronger, and therefore gains instead of losing power when used to impart magnetism to another body. Ordinary magnetism, also, can be readily developed in only a few metals; it is permanent in steel, but transitory in soft iron.

If a permanent magnet be furnished with a soft iron cylindrical

[1] McCulloh, Booth's Encyc. of Chemistry, p. 554.

armature bent into the form of a horseshoe, and each arm of the latter be wound round with insulated copper wire, having its two extremities left free, and if now this armature be made to revolve rapidly, so as to bring its ends alternately near to either pole of the magnet, the soft iron becomes alternately magnetized with opposite polarity, and currents flowing in opposite directions are induced in the copper wire around its arms. If a closed circuit be formed by connecting the free ends of the wire, all of the induced currents will be transmitted; but if, by any suitable mechanical arrangement, the contact be broken during one-half of every revolution, one-half of the currents will be interrupted, and those transmitted will be all in *one direction.* In this apparatus the electricity is *induced* in the wires which surround the armature, and is not derived immediately from the magnet itself. It is upon this principle the magneto-electric machine is constructed.

Electro-Magnetism.—Another form of induction electricity is that indirectly generated by the action of a *galvanic current.* A stout insulated copper wire is wound twice or more around a wooden reel or bobbin, having its ends free for the purpose of being connected with a pair of plates; this forms the *primary coil.* If now we connect the ends with the plates, a current is induced having a direction *opposite* to that of the battery, and on breaking the circuit, a spark is given off, and a current in the same direction or equal to that from the battery is liberated. This is the *primary induced* current, or, as Farady termed it, the *extra current.* Over this coil or helix is now wound a very fine insulated copper wire, say fifteen hundred feet long, the ends of which are attached to connecting posts, from which the current is led for the purpose of being applied to any portion of the body required. If then one end of the inner coil be removed from the battery, the constraining inductive force previously exerted on the outer coil is removed, and all the electricity naturally present in it is discharged through the portion of the body embraced between the directors at the ends of the outer coil, producing an electric shock. This is termed the *secondary induction* current, and is possessed of little quantity and very great intensity. By adding a third coil of fine wire in the same manner, we get a *tertiary induction* current, of still more highly increased intensity. In each coil every interruption of the current is attended by a discharge, one at the instant of making and the other at the instant of breaking the contact. If we place within the reel a bar of soft iron, or a bundle of soft iron wire, it becomes an electro-magnet during the circulation of the galvanic fluid, and there will be developed by magnetic induction a more highly intensified or energetic condition of the induction currents. In the construction of an instrument we may regulate its intensity by the power of the cell used, a large size increasing the magnetism of the core, and thus increasing the effects of the induced currents. Much also depends upon the length and size of the wire forming the inducing coil, the longer and finer the wire, the greater will be the effect, care being observed to equalize the inner and outer re-

sistances of the battery. The effects of the secondary and tertiary currents can also be graduated by making connection at different parts of the wire forming the coils from which they are derived, thus making the wire longer or shorter at pleasure. The strength thus produced may be regulated by the position of the iron core; the further it is introduced the greater will be the intensity; or the core may be more or less surrounded by a metallic cylinder, which intercepts the current of magnetism in that part of the core within it; or the primary coil may be withdrawn from the secondary coil, thus lessening the amount of induction. Such an arrangement, with a device for interrupting the battery current, constitutes the *electro-magnetic* machine. This instrument, to be efficient, should be so constructed that the interruptions may be changed from one or two hundred in the minute to six or seven thousand, thus graduating the current, which should be smooth and regular, from a series of distinct shocks, to an almost imperceptible creeping or tingling sensation. It should also be provided with a pole-changer, for instantly and easily changing the polarity of the current. No instrument is complete without having a good and powerful *primary induction* current.

There is a wide difference of opinion respecting the various apparatus, and the therapeutic value of the different forms of electricity. The *friction* or *static* electricity was for many years extensively employed, particularly by Dr. Golding Bird, in the "Electrical Room" of Guy's Hospital, but it is now nearly altogether abandoned for the *continuous* or *galvanic*, and the more convenient *induction* currents of the present day. Prof. Schwanda, of Vienna, has been advocating and employing static electricity as produced by the Holtz electrophorous machine; it is also suggested to use it for the production of ozone. The continuous current has had powerful advocates among numerous authoritative writers, chief of whom was Remak, of Berlin, who employed it almost exclusively, after repeated trials of both kinds. He seldom used less than a series of ten cups, and sometimes employed as many as sixty, averaging, perhaps, about thirty cells for ordinary cases. Such an arrangement is, of course, only suited for office practice, and is attended with the inconvenience of requiring to be frequently replenished to keep it in good working condition. It should have a key-board, enabling the number of cells in use to be quickly and easily changed, as an important point in its application consists in thus suddenly changing the intensity of the current. Where galvanic cauterization is required the key-board should also enable us as easily to increase the quantity of the current, otherwise it will be necessary to have a separate arrangement for this purpose. When we employ the galvano-puncture as well as the electro-puncture for the treatment of aneurism, this current is necessary. In impaired nutrition, some forms of muscular contraction, paralysis, and neuralgia, it is indispensable. The *magneto-electric* instrument has its greatest advocate in Becquerel, who expresses himself thus: "I am thoroughly convinced that all electro-magnetic instruments, without exception,

must cease to be used in medical practice, and be supplanted by magneto-electric machines." Of the advantages proper to the latter he remarks: "They are very simple, always ready for use, do not get out of order, and can be worked by any one able to turn a crank. They are of sufficient power, and may be readily graduated; and the currents themselves can be made stronger or feebler, direct or retrograde, according to circumstances." With all this, however, there is not that smoothness of the current so necessary in treating cutaneous hyperæsthesia, and in making applications about the head, that we generally obtain from the electro-magnetic machine. Neither are the interruptions as regular, as they are affected by the rapidity with which the crank is turned, and it is almost impossible to preserve the same speed, particularly if this duty is intrusted to another, while the operator is using both hands in making the application: again, it becomes very fatiguing where the action is to be kept up for a long period, as is sometimes necessary, even for hours, in the treatment of narcotic poisoning. The current is valuable, as, in having but one direction, it more nearly approaches the continuous in its catalytical effects, and is prized next to it, by Remak, on that account. But the same results can be obtained from the primary current (which also has but one direction) of the electro-magnetic instrument. The magneto-electric machine is sometimes fitted with an adjustment giving also the alternating, or "to and fro" current.

The *Electro-magnetic* machine has rapidly come into general use, particularly since the publication of the work of Duchenne (de Boulogne), with whom it was the favorite instrument. The objection to it is, that it requires a battery to keep it in action, and, of course, the use of acids, but, with ordinary care, there is no trouble in keeping it in good condition and ready at a moment's notice. It can be made very portable, and since the introduction of the carbon electro-negative, with the use of the solution of the bisulphate of mercury, it can be put in so small a case, that it may be carried in the pocket, and yet be thoroughly effective. This instrument gives a rapidity of interruption that can be perfectly controlled, an intensity that may be imperceptibly graduated from the mildest to the strongest effects, and a smoothness only to be obtained from its automatic vibrator. When properly constructed, it gives not only the induction currents of the second and third order (characterized principally by intensity and alternative of polarity), but also the primary induction current, which has both intensity and quantity, with but one direction, thus producing in a measure the catalytic effects of a rapidly interrupted, though mild continuous current, but with much more intensity.

Means of Application.—Electricity is administered by including a portion of the body between the two excitors or electrodes, thus causing it to form a part of the circuit established. The current is conducted from the positive and negative poles of the battery, or instrument, by means of insulated flexible metallic cords, to the free ends of which are attached the excitors or electrodes, which

are of varied form and size, according to the object to be accomplished and the sensibility of the part to which they are applied. They may be thin metallic plates, with a surface of from two to twelve or more square inches, when we wish to diffuse the current, as in excitation of the cutaneous surface; or where we want to introduce a current of large quantity or intensity, to concentrate it at any given point of exit, by a smaller electrode; or, they may be flat, spherical, olive-shaped or conical terminations of metallic stems, which are provided with insulating handles. These are used for localizing the current on the nerves and the smaller muscles, as those of the face, the interosseous, etc.; they should be covered with moistened muslin or chamois skin. For larger surfaces, hollow metallic cylinders, containing moistened sponges, are sometimes used, but are much less convenient than metallic plates, of the size needed, fastened to insulated handles, to which the sponges are attached. Sometimes a solid metallic body, spoon-shaped, is applied directly to the skin, and intended to act chiefly upon it. Another form is the electrical brush, consisting of a bundle of fine wires, also insulated. This may be moved over the affected part, and occasionally struck lightly upon the skin, or else allowed to remain in contact with it as long as it can be borne. The latter mode is known as the Electric Moxa, and is the most powerful form of local stimulus. When this brush is allowed to remain in contact with the body, it seems as if burning needles were thrust into the flesh; and when struck lightly upon the skin, its effect is only less in degree, because of shorter duration. A much pleasanter brush is the flat camel's hair brush, of the shops, with the tin portion of which the connection is made; it may be had of different widths, from one-half to three inches, and is more agreeable to the patient, when used about the face and neck, than a sponge; we can use either the corner, the edge, or the flat surface of the hair, which should be kept thoroughly moistened. In applying the current to the forehead, or over other sensitive points, it may be passed through the hand or fingers of the operator to the part with much more delicacy than by any other means. This is different from the electrical hand of Duchenne, where one pole is adjusted to some portion of the body, possessing but little sensibility, as the sacro-lumbar region, while the other is held by the operator, who, after having dried the skin perfectly, passes the back of his hand over the portions of the skin he wishes to stimulate. If the current is very intense, there is a sharp, stinging sensation, accompanied by a loud crackling noise, and it will, if continued, produce an erythematous blush, lasting for some minutes. When the dry spoon-shaped body is used, the skin becomes very red, and as painful under the application as if the surface were blistered. It is less severe, however, than the moxa.

Golding Bird has recommended the employment of a single pair, made by connecting a very thin plate of zinc, by means of an insulated copper wire, with a plate of silver. They are generally from one to two inches square. They are applied directly on the

skin, the silver always being at the distal extremity, as the current flows from the zinc through the tissues to the silver, and then through the wire back again. They are sometimes useful in the treatment of persistent rheumatic and neuralgic pains, but particularly in *chronic ulcers*. The silver is placed over the ulcer, or a moist cloth may be interposed, while the other plate is placed a few inches above. In a short time the skin beneath the latter becomes whitish; then the plate should be removed to a new place; otherwise, in twenty-four hours a sloughing ulcer may be the result, which is partly due to the action of the chloride of zinc formed. Should it occur, it is to be treated by placing the silver plate over it, when a rapidly healing action ensues, excepting in those who are very anæmic. Where a speedy and more powerful action is required, the surface is blistered on each side of the affected spot; the plates are then laid on the denuded surfaces. Of course, increased attention must be given to the action of the zinc plate under such circumstances. Pulvermacher's "Hydro-electric voltaic chain" consists of a number of little batteries, each formed of a small piece of wood, with a copper and zinc wire spirally twisted around it, the terminals of each being united with those of the next block; the zinc of one, to the copper of the next. Twenty or thirty of these form a chain, the ends of which have small brass plates attached as excitors. These have elastic straps to retain them in any desired position. The copper termination is the negative pole. They are set in action by dipping them in vinegar, the wood remaining moist enough to keep them running for some time, producing an electricity of high tension and but little quantity. The current is often irregular, and when the joints are destroyed it becomes worthless.

Action of the several Forms of Electricity.—Allusion has already been made to the effect of the static form of electricity, and it need only be added that it produces in a slighter degree nearly the same effects upon the organs of special sense, that result from the other forms of the current. *Galvanism*, applied to the skin, excites more or less of an inflammatory condition, attended with a sense of burning; when used as a *constant* current, that is, without interruption, the sensation varies from a slight tingling to an almost intolerable pain, according to the intensity employed; and if maintained for several minutes, may produce ulceration and destruction of the skin and subjacent structures. It will increase and diminish sensibility, relieve pain, restore lost sensation, and change temperature; it is a tonic and increases nutrition; it acts powerfully on the muscles and augments their endosmotic action, as shown by their plumping up after having been under its influence; it increases and lessens their irritability, as well as that of the nerves, restores their contractility, stimulates the secretions and the circulation, coagulates blood, causes the removal of tumors and effusions, increases the activity of the lymphatics and glandular system, and promotes the resorption of exudations. When the current is intermittent, these effects are materially diminished, while

the contractile effects on the muscles are very much increased, and its peculiar energy of action on the retina most strikingly developed. If the current, about the face or scalp, be rapidly opened and closed, it produces a succession of brilliant flashes; hence, its advantage over other forms, when the indication is to stimulate the retina, and the necessity of avoiding such applications where such a result is contra-indicated. It is not, however, without some risk, as permanent amaurosis may be produced from over-excitation. Duchenne speaks of a case in which, when this current was applied for paralysis of the portio dura, loss of sight of that side resulted, the patient exclaiming that he saw the whole room in a blaze. At that time the reason of this effect seems to have been unknown.

Magneto-electricity, and the primary induction current, both act powerfully on the muscular contractility, and are capable of producing decided effects upon the retina, even when of low intensity. They also stimulate, but less energetically than the galvanic current, the different organs, by increasing their functional activity. No disorganizing or inflammatory results attend their use. The power to regulate the rapidity of their interruptions renders them particularly useful in the treatment of the different forms of *paralysis*. Where the lesion is of central origin, or where the nervous system is hyperæsthetic, or very susceptible, we may safely use them with the slow vibrations, where the more rapid succession of shocks might be too painful or stimulating. The effects of the secondary induction current, while somewhat similar to those of the other induction varieties, are only so to a slight degree. Its most marked results are found in its action on the sensitive nerves.

Direction of the Current.—While much of the result of electricity is due to the kind and quality of the current used, as well as the method of application, a great deal depends on the *direction* of the current. When it is made to traverse the nerves in their course, that is, from the centre to the periphery, it is termed the *direct* or *descending* current; and when it is from the periphery to the centre, it is called the *inverse* or *ascending* current. These terms should not be confounded with Duchenne's designations of *direct* and *indirect* faradization, the former having reference to the immediate application of the excitors over the muscles, and the latter to their position over the nerves supplying them. Sometimes the word *direct* is improperly used to designate the primary induction or extra current of Faraday; and not infrequently it is intended to refer to the galvanic current; it should only be used to indicate the downward direction of the current. A descending current may be made to go *to* or *from* a painful spot according to the position of the electrodes; the former, if the negative pole be placed over it; the latter, if it be covered by the positive. In the first case we have increased action at the point of treatment; in the second, we have diminished action. A great diversity of opinion prevails in regard to the direction in which the currents should run in their therapeutical employment. It would seem, from the immense dynamic power peculiar to the galvanic current and the comparative want

of it in the induced varieties, that the question of direction applied particularly to the former; but in practice the same rules will generally be found to hold good for both kinds. There are electro-physiological facts which in many cases may determine whether the current should be direct or inverse. It is claimed that excitability and reflex action are increased by the ascending, and diminished by the descending currents; that the sensory nerves are most powerfully stimulated by the ascending, and the motor nerves by the descending current; that when a current ascends through the spinal cord, the motor nerves are acted upon by direct action, and by reflex action when it descends.[1] According to Remak, the positive current reddens the skin, depresses it, and relaxes the bloodvessels, whereby circulation and absorption are facilitated, while the negative pole produces directly opposite effects. Hence he used the direct current for stimulating relaxed and paralyzed muscles, and the inverse for overcoming spasm and contraction. In the relief of pain, he used the descending current, placing the negative pole on the tender surface, unless there was active inflammation, when the direction should be reversed. He believed that a conveyance of liquids was effected between the electrodes proceeding in the direction from the positive to the negative pole. A favorite method of Remak's was what he termed the *circular method*, in which he placed the positive over the central inflamed point and carried the negative in radii of from four to six inches away from it. Reynolds, in speaking of the direction in the relief of pain and spasm, says that "so far as he has seen, it does not make the smallest difference which is used."[2] He says, "the over-activity of a motor nerve or vessel may be reduced by the application of a constant galvanic current applied in the downward direction, if not strong enough to produce pain or irritation of the skin."[3] Also, "that while a continuous downward current diminishes irritability and the upward current increases it, he has never seen any difference due to the direction when the electrodes are kept moving, or where the current is interrupted."[4] MM. Onimus and Le Gros state that the descending current increases in a marked degree the circulation, while the ascending current does so to a less extent, and sometimes even has an opposite effect.[5] Dr. Hammond, on the other hand, in the treatment of spinal disorders, recommends the descending current for contracting the vessels, and the ascending for relaxing them. The induced currents act more powerfully on the sensory and motor nerves at the negative pole. In relieving general nervous excitability, a direct secondary current applied over the entire body produces the happiest effects; while in debility and nervous depression, a similar application of inverse currents causes decided stimulation, and occasionally the remark from patients that "they feel as if they had taken a glass of brandy." Drs. Beard and Rockwell

[1] Mémoirs de la Société de Biologie, Mai, 1868.
[2] Clinical Uses of Electricity, p. 10.
[3] Ibid., p. 58.
[4] Ibid., p. 66.
[5] Traité d'Electricité Médicale.

advocate the use of the descending secondary current, sponging the body with the positive electrode, as a tonic treatment. The direction becomes a very important consideration in the treatment of the nerves and muscles, reference to which will be made in speaking of the effect of the current on these organs.

Action of Galvanism upon the Brain and Spinal Cord.—The brain and spinal marrow are now conceded to be within the reach of the current by external application. Althaus, however, contends that the cerebral effects are due to the reflex functions of the fifth pair of nerves. A mild galvanic current applied to certain parts of the head or face may produce pallor, giddiness, vomiting, and fainting, increase or diminish headache, etc. Applied directly to the medulla oblongata the motion of the heart grows slower and its walls become relaxed. Matteucci applied the poles of a voltaic pile to the corpora quadrigemina and crura cerebri producing cries as of pain, and muscular contractions of the entire animal. The induced current does not produce cerebral effects unless upon those who are unusually susceptible to such influences. A continuous current of galvanism passed through the spinal cord, diminishes or inhibits its susceptibility to irritation, so that mechanical or induced electrical stimulation fail to excite it. An induced current passed through its entire length throws all the muscles into strong convulsions, while interrupted galvanism produces contractions on opening and closing the circuit. The *sympathetic* nerve is also decidedly influenced by the application of electricity. Claude Bernard found that contraction of the pupil, flattening of the cornea, injection of the conjunctiva, increased temperature and sensibility produced by cutting through the cervical sympathetic nerve, were all relieved by galvanizing the cranial end of the nerve. The action of the heart is accelerated by galvanizing the inferior cervical ganglion, while it is retarded by acting on the pneumogastric. The portion of the spine between the seventh cervical and the sixth dorsal vertebræ is termed by Budge and Waller, the *cilio-spinal region*, because they found in applying to it an induced current, the pupil became dilated. Prof. Budge has also called attention to the effects of induced currents applied to what he terms the *genito-spinal ganglion* near the fourth lumbar vertebra. Similar excitation of the region of the fifth cervical vertebra also produces the same effects; these are the contractions of the rectum, bladder, and vasa deferentia.[1] If the splanchnic nerves, springing from the six lower dorsal ganglia of the sympathetic, are strongly galvanized, the peristaltic action of the intestines ceases, while it is increased by a gentle current.

Muscular Electrization.—*Faradism* is a term given to induction electricity by Duchenne, in honor of the eminent chemist and electrician Faraday; to the application of this current he has given the name of *faradization*. In order to stimulate a muscle, the application may be made either through the nerve supplying it, by

[1] VIRCHOW's Archiv, 1859, p. 115.

placing the excitors near each other, over its most superficial portion, when one or all of the group of muscles under its influence may be acted upon, or, we may operate through both nerve and muscle, by placing an excitor on each, or we may place both of them on the muscle, thus limiting the action to it. The skin should be thoroughly moistened, and the excitors covered with wet muslin or chamois leather. If the muscle be superficial, a moderate amount in quantity or intensity may be used, with but little pressure. If it belong to a deep group, we should increase both of these conditions, making a firm or alternating pressure according to the effect to be produced. The pressure, by diminishing the sensibility, enables us to use a greater amount of power with less pain. To act on the entire muscle, its whole surface must be traversed by the excitors. To produce a calming soothing influence, often relieving pain, we should use excitors with large surfaces, and they should be applied and removed slowly; or, the current may be gradually increased after applying, and decreased before removing them, to avoid anything like a shock. This peculiar mode Remak termed *stabile*. The "Labile" method requires generally smaller directors, and is produced by varied pressure, and a constantly changing position of the directors. This produces powerful contractions, giving tone and strength to the muscles, stimulating them when relaxed, and overcoming the effect of the *stabile* current, if it has been too long continued. The magneto-electric and primary-induced currents act energetically on the muscular contractility; the latter is not as painful as the former, but is attended with more of the burning sensation, and if the intensity be high, there is generally an aching, which may remain some time after the application has ceased. This is seldom the result where the interruptions are slow, even though the intensity be very much increased. The secondary current produces contractions, but it requires so much intensity, that the application is usually very painful. It is seldom or never necessary to use either a greater quantity or intensity than is sufficient to produce the desired amount of contraction. If the muscles are painful and irritable, the current should be smooth and regular in its interruptions; the application should be made gently, with a steady and uniform pressure, beginning always with a feeble current, and gradually increasing its strength until we have reached the requisite power. If much action be required, and if a good degree of excitation be well borne, frequently and suddenly changing the polarity by means of the pole changer, or the continued reversal of the position of the excitors, is to be practised. These methods, particularly the first, are powerful means of exciting muscular contractility, and must be used with caution, and not at all in those diseases which are of recent central origin.

Action of Electricity on Muscles and Nerves.—The muscles conduct electricity better than any other portion of the body, owing to the greater amount of salines and water contained by them. According to Eckhard, the resistance offered by the various structures is as follows: Muscle, 1; cartilage, tendon, and nerve, about 2; and

bones, 19. The entire body is said to conduct four times better than water. The influence of a moderately strong induced current on a healthy muscle is to develop a series of very rapid contractions, continuing during its passage, and to augment both bulk and temperature. If the current is very strong, it may produce aching with a sensation of fatigue, and if long continued, a loss of power. When a muscle acts but feebly, or fails to contract under the induced current, the passage of galvanism through it for a few moments either increases or restores the contractile response to the induced current; the alternate use of the two kinds often increases the contractions very decidedly. Faradic contractions show but little change throughout an application, while those produced by galvanism generally grow stronger. A constant current of galvanism passed through a motor nerve, excites contraction in the muscle to which it is distributed, only at the opening or closing of the circuit, or under a change of its intensity, thus resembling the action of the induced current, which we know results from the opening and closing of its battery current. The susceptibility of a muscle to these contractions is termed *electro-muscular contractility;* the sensation experienced during the contraction is termed *electro-muscular sensibility.* If we use a strong and continuous galvanic current, we get not only the opening and closing contractions, termed *clonic*, but we frequently find them remain during the continuity of the circuit, and often accompanied by a sense of vibration. Remak called them *galvano-tonic contractions*, and attributed them to the varying density of the current. We find a difference in the muscular response at the making and breaking of the circuit, depending on its strength and variations. The experiments made by Pflüger led him to establish the law, that on opening a feeble current either direct or inverse, we get contraction; on closing it, rest; with a medium strength we have contraction in either direction on both opening and closing; and with a strong current, *direct*, a contraction on closing, and rest on opening; *inverse*, rest on closing, and contraction on opening. According to Volta, a galvanic current, if continued sufficiently long through a nerve, will paralyze its action; if the direction of the current be reversed the nerve may be restored to its normal condition; this may be repeatedly produced; these changes are called *voltaic alternatives.* A muscle is said to be *tetanized* when it remains contracted during or after a prolonged application of galvanism through its nerve. If galvanism is passed through a nerve or muscle there is produced around the position of the positive pole or anode, a diminished degree of irritability which is termed *anelectrotonus;* around the position of the negative pole, or cathode, there is an increase of irritability, *catelectrotonus.* These states soon disappear after the withdrawal of the current, remaining much longer, however, with the nerve than with the muscle.

Remedial Employment. *Paralysis.*—There is no class of affections in which the curative powers of electricity display themselves so strongly as in paralysis. But here, as might be expected,

a great difference is to be observed according as the paralysis depends upon a peripheral or a central cause. When cerebral or spinal hemorrhage, or softening, or any other lesion has broken up or disorganized the tissue of the brain or spinal marrow, it is in vain to expect that the muscles which derive their power from the injured part can ever be restored to their original condition. Electricity can only incite to action organs that are not wholly disabled, and in which a power of regeneration exists. Hence, peripheral paralyses are those in which the curative powers of this agent are most decided and prompt in their operation; next in order come those in which the central lesion is one susceptible of repair.

It may not be amiss to inquire briefly in what manner electricity affects paralyzed muscles, and how far it is valuable in aiding us to make a diagnosis. Dr. Marshall Hall, probably the first to direct attention to this use of the current, designates as *central* paralysis, that form in which the influence of the brain is severed; and that form as *spinal*, in which the influence of the spinal cord is severed. He says the muscular irritability is augmented in the first, and diminished in the second form. As a test, he used the mildest form of the continuous current capable of producing a perceptible effect. On the contrary, Dr. Todd, after testing a number of cases with each form of electricity, has ascertained that generally there is a diminution of contractility; that in some cases there is an augmented irritability, which is always associated with more or less rigidity of the muscles of the affected side. In such cases there is a central source of irritation, as effusion or hemorrhagic clot. The rigidity is due to the excited molecular condition of the brain or spinal marrow, and is identical with that spontaneous jerking of the limbs frequently observed under the same circumstances. In another class of cases, generally the result of apoplexy occurring in persons of previous good health, and in whom the paralysis is almost complete, there is no difference in the excitability of the muscles of the healthy and paralyzed limbs. The muscles are more or less atrophied in those cases in which the current fails to develop contractility. Althaus, also, has tested the muscular irritability in more than a hundred cases of cerebral paralysis with the same results.[1] He says: "There is no other form of paralysis except that produced by an irritative lesion of the brain, in which the excitability of the paralyzed muscle is exalted. If, therefore, the muscles of a paralytic limb are, by a current of the same intensity, more powerfully convulsed than those of the sound side, we may fairly conclude that the paralysis is due to brain disease, and that the lesion is of an irritative character."[2] Dr. Grier's observations in a large number of cases accord with the above. Duchenne says the electro-muscular contractility is always in its normal state, and the electro-muscular sensibility is, in gene-

[1] On the Value of Galvanism in the Treat. of Paralysis, Neuralgia, etc., p. 54.
[2] Ibid., p. 60.

ral, intact.[1] These differences may be partially accounted for by the variety and modification of currents used, and the time at which they were employed. In many cases of cerebral paralysis, in the first few days, muscular irritability is diminished or lost; then for a few days more it may be normal, and afterwards may remain so, or become considerably augmented. A weak muscle will often respond to mild galvanism when the circuit is very slowly opened and closed, while it would entirely fail if we used either very rapid interruptions or the faradic current. Electricity becomes an aid in the *diagnosis* of paralysis by determining the irritability of the muscles. We should commence by testing with a feeble current, and increase it until we ascertain the amount sufficient to produce contraction in the muscles of the healthy side, and then taking care to pass the current in the same direction, test the corresponding muscles of the affected side. The response may indicate a normal, an augmented, or a diminished irritability. According to Onimus and Le Gros, *if the contractility of the muscles to induction currents be normal*, neither the muscles nor the peripheral nerves, nor that portion of the cord in which the nerves originate, are the seat of the lesion. If the contractility to induction currents be diminished, while it is either normal or increased to galvanism, the inference is that the motor system alone is affected, and that the muscular fibres are not seriously affected. If the contractility to induction currents be abolished, while it is increased to galvanism, the motor nerves are completely involved, and the paralysis is of peripheral origin. The muscles are altered, but the alteration is not yet of a grave nature. If the contractility to induction currents be abolished, and the contractility to galvanism is feeble, there has been rapid destruction of the various nervous filaments and serious muscular lesions. If treatment restores galvanic contractility a cure is possible. If contractility to both currents is abolished, we may infer a complete destruction of the affected nerves and muscles.[2] If there is too much irritability in the muscle, there is probably an irritable condition of the brain, or cord above the spinal origin of the nerve. Reynolds thinks this is due to an increased vascularity of either the structures of the brain or cord, or their membranes. We may have diminished irritability, caused by impaired use of the muscle, either from want of use or an impoverished or altered condition of the blood, from a lesion of the nerve supplying the muscle, or from a disease of spinal cord or brain. In the treatment of paralysis of central origin, it has been recommended to defer the use of electricity for a period of from four to eight months, until a hemorrhagic clot may have been absorbed, or the surrounding tissues have become accustomed to its presence, and the irritability have ceased, or the repair of the lesion have proceeded so far as to permit the application of some form of the current. There is usually no reason why the treatment should

[1] L'Electrisation Localisée, 1861, p. 340.
[2] Traité d'Electricité Médicale, p. 621.

be deferred more than two or three weeks; about this time judicious applications of galvanism may do much to remove the cause and reduce the irritability by promoting absorption and increasing nutrition of the affected part. Faradism also becomes an important remedy in its general application to the entire surface, increasing the cutaneous circulation and temperature, and acting as an efficient tonic. Perhaps its greatest value at this time is in its power, by stimulating the nutrition of the muscles, to prevent their atrophy, which would have occurred to an almost irreparable degree during the months of waiting for the removal of the sources of irritation.

In such cases, when the faradic current is used to stimulate the motor nerves, the vibrations should be slow, the application of short duration, and the direction of the current downwards. Care should be observed that the peripheral excitation may not overstimulate the reparative processes going on in the cerebral structures, or reproduce the original lesion. When the general application is employed, the current should be of moderate strength to the hand, and the interruptions exceedingly rapid. In using galvanism, the applications should be of short duration, and the current of moderate strength; perhaps from eight to twelve Daniell's cups. Remak advised galvanization of the cervical sympathetic nerve, claiming to have obtained complete recoveries in cases which would have been, otherwise, incurable. At a later period, when the irritability has appreciably diminished, we may obtain very satisfactory additional results from the electrotonic effect of an inverse current applied to the base of the spine. Galvanism should also be employed for local stimulation of the muscles.

In all cases of paralysis which are independent of structural lesions of the nerve centres, hopes of restoring activity to the muscles may be certainly entertained. In such cases no time should be lost in waiting for the effect of the usual remedial agents generally employed, for it is in such cases that electricity exerts, most evidently, its anti-paralytic powers; the more recent the attack, the shorter, generally, will be its duration. Friedberg[1] has shown that a great variety of muscular paralyses, accompanied with wasting of tissue, may be cured by magneto-electro stimulation. The cases cured by him comprise atrophy and paralysis caused by inflammation of a joint beneath the affected muscles, the deltoid and glutei for example; by blows, burns, dislocations, rheumatism, typhoid fever, and traumatic inflammation of the spinal cord.

We frequently meet with paralyses in which the conducting power of the nerve is affected as the result of injury, inflammation, or pressure; in other cases the lesion is purely muscular, due to external violence, interrupted circulation, or an altered condition of the blood causing impaired nutrition, etc. The electro-muscular

[1] Pathol. und Ther. der Muskellähmung, Weimar, 1858.

contractility and sensibility are more or less impaired, according to the severity and duration of the affection.

Rheumatic paralysis may occur suddenly after exposure to a draught of air, changes of temperature, etc., when it is characterized by inability to use the affected part, with an aching pain generally during the attempt. If the affection is of long duration, the rest and sometimes the various positions assumed to relieve the pain, give rise to muscular atrophy as in paralysis of the deltoid, and to distortion, as in torticollis. Here the loss of contractility is also irregular, generally responding better to a mild and slowly interrupted galvanic current, than to the rapid interruptions of either galvanism or electro-magnetism. As the condition improves, the current will have to be increased in strength, with more rapid openings and closings, until towards the end of the treatment, when we shall find a normal response to the induced current. The pain may be relieved in treating the tender region by passing a rapidly interrupted faradic current over it, or by galvanizing it with a dry metallic electrode connected with the negative pole. It is not unusual, during successful treatment, in its early stage, to find the muscular volume diminished for a time, after which it regains its normal size.

The peculiar form of paraplegia known as *tabes dorsalis*, which consists of a loss of power to maintain the erect position, although the muscles of the lower extremities display their full power in the recumbent position, has been successfully treated by Remak, by the labile action of the continuous galvanic current, directed through the nerve-trunks of the inferior extremities. The cases which he relates leave no doubt of the possible curative virtues of the agent when appropriately employed.[1] He also speaks favorably of its results in this affection, using the centripetal current through the arms, in a case which had resisted the action of the induced current for three weeks.[2]

In *hysterical paralysis*, generally, the electro-muscular sensibility is greatly diminished, and in some cases is totally absent, while the muscular contractility remains perfect. Meyer gives as the characteristic signs of this form of paralysis, the coincidence of the actual paralysis, with anæsthesia of the skin and muscles, and the frequent transition, as the case proceeds, from anæsthesia to hyperæsthesia, and from a low to a high degree of motor irritability. In all cases electric treatment should be tried, testing the affected muscles with both induced and galvanic currents; if there is much nervous excitability we should begin with a downward, fine induction current of the second order, gradually increasing the intensity as the patient will bear it.

In *lead palsy* the extensor muscles of the arms are nearly always affected, while the flexors remain comparatively free; the muscles become atrophied, and the excitability very much or totally di-

[1] Galvanotherapie, Remak, Paris, p. 546. [2] Ibid., p. 440.

minished. The peculiarity presented is the "*dropped wrist.*" Sometimes the lower extremities are affected, and in a few cases the paralysis is general. These cases are especially benefited by electricity, alternating the galvanic and induction currents, using labile applications, and stimulation produced by sudden and frequent reversings of the primary induction current. In a case of Dr. Grier's of two years' standing, characterized by general paralysis, chronic diarrhœa succeeding obstinate constipation, relaxation of the sphincters, frequent attacks of colic, with continued chilliness and great nervous prostration, a marked and rapid benefit followed the application of a current from ten Grove cells, the patient reclining in a tepid bath for from five to ten minutes, holding the positive pole in his hands, while the negative was passed through the water, as closely as possible without touching, over the whole body; these baths were used every other day, while on alternate days the muscles received direct and indirect faradization, with a slowly interrupted primary current. At the end of two months he was able to walk without crutches, had regained control over the extensors of the arm, and was rapidly gaining strength; his bowels acted naturally every day. In another month he was able to return to his original occupation of farming, having abandoned that of painting.

Paralysis of the Bladder and Rectum.—Organic muscles respond to the galvanic stimulus much more slowly than the voluntary muscles, the response sometimes not appearing until sufficient time has elapsed to permit the removal of the electrodes. The rectum and bladder respond quite freely.

After parturition, when retention of urine occurs from loss of power in the bladder, galvanism has been used successfully to restore it. It seems to have been first employed for that purpose by Dr. Goodwin, of Manchester.[1] Dewees cured a case of paralysis of the bladder and rectum produced by concussion of the spine, by passing a continuous current from the rectum and spine to the supra-pubic region, and through the urethra by means of a silver catheter, the positive pole being placed upon the spine. A similar one is related by Löschner, and another by Pétrequin, who points out, as the appropriate cases for this treatment, retention of urine after concussion, rheumatism of the bladder, and inertia of this organ, produced by poisoning with charcoal vapors, or by the abuse of alcohol. Even when the retention is due in some degree to a stricture of the urethra, or an enlarged prostate gland, the power of the bladder may be increased to such a degree as to overcome the resistance presented by the mechanical obstacle to the discharge of the urine.[2] In all of the cases, the successful operation of the electric stimulus must tend to prevent the decomposition of the urine, and the ulterior mischief to the bladder which that change tends to occasion. Duchenne has reported the cure by its means

[1] RANKING'S Abstract, i. 176. [2] Bull. de Thérap., lvi. 508.

of a case of prolapsus of the rectum in a man forty years of age, and who had suffered with this infirmity from infancy.[1]

In paralysis of the bladder from over-distension, in atonic paralysis of its muscular coat in children, and where it is the result of old age coming on gradually, galvanic stimulation is attended with beneficial effects. Where it is an attendant of the weakness of the genito-urinary apparatus, caused by excesses, it acts efficiently, and generally very promptly; in a number of cases from three to five applications being sufficient. In paralysis of the accelerator urinæ, resulting from the same cause, as well as from injuries of the perinæum, it has been effective in eighteen out of twenty-four cases treated by Dr. Grier. The interrupted galvanic current of from four to ten cups of the modified Bunsen battery, or the primary induced current slowly interrupted and of high intensity, should be used for a few minutes; the current should be introduced into the rectum or urethra, by means of the proper electrodes attached to the negative pole, while the positive is placed over the perinæum. In *prolapsus of the rectum* and in *hemorrhoids* an inverse direction of the current just spoken of (from the perinæum and rectum to the umbilicus and lumbar region), has succeeded in affording relief and often permanent cure to a large number of patients.

Aphonia.—In some of its forms it is readily cured by the current, particularly where there is no organic trouble. When due to the prolonged use of the vocal organs, anæmia, nervous excitability, tobacco, chronic laryngeal congestion, chronic bronchitis, etc., cures have been made after the failure of other remedies. In two cases of nervous aphonia under the care of Dr. Grier, the loss of voice was only noticed after sleeping, lasting from fifteen to thirty minutes or longer, when it either suddenly or gradually disappeared. In one lady, it was only noticed in the morning. In the other it occurred always after sleep, even though it was but a nap of a few minutes. General applications of the secondary induction current and local treatment from the neck to the throat and chest, with a fine vibration and as much intensity as could be borne, resulted successfully in from three to five weeks. In another case, the aphonia was always preceded by a crop of vesicles covering the mucous membrane of the throat, and lasting for a day or two of each week. This man had been an inveterate tobacco chewer, up to the previous year, when he was advised to discontinue its use, but without relief. Three weeks' daily application of a very fine primary induction current from the back of the neck to the lining membrane of the fauces effected the cure. The current may be localized in the throat by means of the laryngeal excitor; this is provided with a spring, by which the circuit can be closed and opened at pleasure; by the aid of the laryngoscope the current may be applied directly to the vocal chords; in this manner they have been successfully treated for paralysis. Dr. Morell Mackenzie has

[1] Bull. de Thérap., xlv. 562.

applied a galvanic current directly to the muscles of the larynx engaged in phonation,[1] thus succeeding in restoring the voice with singular rapidity after the failure of vesication, cauterization, etc. It was equally successful in the practice of Dr. Stokes and Dr. Smyley,[2] and also in the hands of Dr. J. Solis Cohen, of this city. Grapengiesser, of Berlin, reports a case cured by him in which loss of voice and hoarseness had continued for four years, and which had been unavailingly treated with counter-irritants, etc. He vesicated both sides of the larynx, and attached a zinc plate to one and a silver plate to the other. When a connection was made between the two, severe and convulsive movements of the larynx were produced, the pain being less while the circuit was closed than when it was alternately closed and opened. It was continued for fifteen minutes. After dressing the sores, which discharged copiously, the spasm continued for fifteen minutes. In two hours the patient began to speak more audibly, but the improvement ceased after a few days. The application was then renewed, and the voice was permanently restored.[3] Sedillot has reported the case of a woman who had lost both voice and speech for twelve years, in consequence of a fright which produced paralysis of the genio-glossi and the muscles of the vocal chords. She began to articulate distinctly after the second application of the poles of an induction apparatus, and, after several more, perfectly recovered her speech.[4] Dr. Althaus cured eleven out of fifteen cases, employing no medicines, in order to test the value of electricity. He used a mild induced current, directing the electrodes partially to the recurrent nerve and partially to the tissue of the crico-thyroid muscle.[5] All of the patients were women, the affection consisting merely in loss of power in the nerves and muscles of the larynx. Dr. Reynolds recommends insulating the patient and drawing sparks of static electricity from the larynx; a few sparks often curing cases where the more painful application of the other forms had failed. It is immaterial whether the patient is positively or negatively charged.[6]

The optic nerve is readily excited, all forms of electricity being capable of acting on the retina; galvanism produces the greatest, and electro-magnetism the least effects. Opening and closing the circuit gives brilliant flashes of light, varying in color and brilliancy according to the intensity and direction of the current. These effects are said to be reflex, following excitement of the fifth pair of nerves. This fact should be remembered in galvanizing the face. Duchenne records a case where a powerful current applied to the portio dura, resulted in blindness of that side. A very gentle current should be used, opening and closing the circuit, and alternating its direction. In this way many cases of weakness of sight and exhaustion resulting from a prolonged use of the eyes may be bene-

[1] Times and Gaz., Feb. 1863, p. 184, where a cut of the instrument is given.
[2] Ibid., July, 1863, p. 39; Dub. Quart. Journ., Aug. 1863, p. 244.
[3] Dublin Journ., Feb. 1847, p. 108.
[4] Lancet, May, 1856, p. 516.
[5] Treat. on Med. Elect., Philada., p. 288.
[6] Clinical Uses of Electricity, p. 94.

fited; the treatment with galvanism should be of very short duration; that of electro-magnetism may be continued from five to ten minutes. Faradization or galvanization, separately or alternately, may be advantageously used in ptosis and strabismus. Crussel and Lerche[1] found that the zinc pole of a voltaic pile rendered the lens opaque, and that the opacity disappeared under the influence of the copper pole. Crussel attempted the cure of *cataract* by electro-puncture, resulting in inflammation and destruction of the eyeball.

Amaurosis.—Before applying electricity to the eyes, an ophthalmoscopic examination should be made, as there are conditions thus revealed in which no indications would be met by the use of the current, and in which it might be contraindicated. When this affection depends upon a general cachexia, such as may be produced by the advance of old age, an impoverished condition of the blood, upon Bright's disease, or diabetes, electricity can be of little avail, and the same may be said of the cases due to an organic affection of the brain or optic nerve. When depending upon paralysis of the fifth pair, rather than of the optic nerve, it has frequently been cured by passing the current across the orbit. A positive electrode may be introduced into the nostril or mouth, while the negative is brought into connection with the frontal nerve; or it may be passed between the temples, or from the occiput to the superciliary or infra-orbitar foramen. Mr. Ware considered electricity more useful in amaurosis from the effect of lightning on the eyes, than in any other variety of the complaint.[2] Becquerel advises that localized electrization, using magneto-electric currents, by means of moist sponges applied around the orbit and over the closed eyelids should be tried. If we use the constant current, from two to six of Daniell's cups will be sufficient, using fine sponge-covered metallic electrodes, or sable-hair pencils well moistened with water. In many cases of simple weakness of the eyes, and when they are fatigued from over-exertion, the application of fine secondary currents from the back of the neck to the eyes, using the eye-cup filled with water, and connected with the negative pole, produces a feeling of relief and stimulation. Photophobia is frequently relieved by the same current passed through the hand or soft brush, from the forehead and eyes to the neck and shoulders. The photophobia incident to strumous affections of the eyes, has been very successfully treated by means of the continuous galvanic current.

Dr. A. Hewson, to whom we are indebted for this addition to electro-therapeutics, thus describes his mode of procedure: "The form of apparatus employed by me was the Pulvermacher's chain battery of sixty links, with ordinary vinegar as the chemical agent. The electricity from this I applied by moist conductors, which consisted of brass rods six inches long, slightly curved and surmounted at one end with a wooden handle, and at the other with a small brass cup filled with wet sponge. These conductors were hooked

[1] Medizinische Zeitung des Vereins, 1841. Quoted by Althaus.
[2] Mackenzie, Dis. of the Eyes, 2d ed., p. 917.

to the end of the chain, which constitute the poles of the battery, and I applied the sponge of the one attached to the negative pole to the skin over the supra-orbital foramen, whilst I made frequent contacts with the sponge of the other to the skin of the forehead at various points. These applications were generally made at intervals of three or four days, and only for a minute or two each time; and I would caution all who may resort to galvanism for these purposes not to attempt its too frequent or protracted use, for there is danger of permanent injury to the retina from such uses of it, as has been pointed out by M. Duchenne."

The following is an abstract of the results obtained by Dr. Hewson: "Of nine cases in which the photophobia was *intense*, two (both cases of pustular corneitis) were so much relieved by the first application that they were out of doors the next day, playing about in the strong sunlight; three were relieved, and only one improved by the first application; three were not apparently affected by the first application, but improved by the second, and decidedly relieved by the third. Of the twenty-one where the photophobia was *considerable*, ten were relieved by the first application, and eleven only improved, but relieved by the second. Of the two in which this symptom was but *slight*, both were cured, one by the first, the other by the second application.[1]

In a case of occlusion of the *tear duct*, following an attack of coryza, a cure was effected by the use of the rapidly vibrating primary current. The positive pole was a small sable brush, passed over the tract of the duct, while the negative, a small sponge-tipped, metallic director, was placed within the nostril. Another case of five months' duration was cured by a current from six Daniell's cups, the same application of the electrodes having been made; this case was treated every other day for two weeks with this current; electro-magnetism for the same period had failed to accomplish any apparent effects. The same treatment as in the latter case (five applications of galvanic current, six cups) cured a lady of ulceration of the right tear duct of two weeks' standing. The starting point was a violent attempt to "squeeze out the contents of a little white tumor" situated over the course of the duct.

Loss of Smell.—Electricity acts as a stimulant to the olfactory nerve, and is sometimes successful in restoring its lost function. Ritter experimented upon himself with a voltaic pile of twenty-five pairs. When the current was direct, closing the circuit provoked an ammoniacal smell and sneezing while it continued; on opening the circuit, an acid taste and loss of power to sneeze occurred, remaining for a short time. When the current was inverse, during the closed circuit there was the acidity without the sneezing power; but this returned with an ammoniacal odor when the circuit was opened. One of Dr. G.'s patients who smoked almost continually and discharged the smoke through the nostrils, after noticing an *increase* in the perception of odors, found the sense of smell gradu-

[1] Am. Journ. of Med. Sci., Jan. 1860, p. 114.

ally *disappear* until it was entirely lost. While under treatment for a sprained ankle, he spoke of this fact, and it became the subject of experiment. He refused to discontinue his favorite method of smoking, as he did not expect any good results to follow the attempt. Eighteen applications were made with the inverse primary current of low intensity rapidly interrupted; the positive pole was passed up the nostril over the Schneiderian membrane, and the negative was placed over the back of the neck and on the tongue alternately. At the sixth application he could distinguish cologne water from diluted alcohol, and from this time continued to improve.

At first the most marked improvement seemed to follow the application of the negative to the neck, while towards the close, it was greater from the application of that pole to the tongue. The Schneiderian membrane is so sensitive that it is necessary to begin with very mild currents until tolerance is established, to avoid the otherwise inevitable sneezing. In this case, however, the general sensibility was so much impaired, that he did not suffer any inconvenience from the applications until during the last few days of the treatment. The most sensitive part of the membrane is just within, and at and above the union of the mucous membrane and the skin; at this point there is the usual sensation of pricking, while higher up it changes into a feeling of fulness and irritation, more like an aching. During the above applications, the *extra current* developed may affect the dental nerve and give rise to a more or less severe toothache; this may be avoided by changing the position of the electrode on the neck.

Coryza.—Dr. Grier has almost daily treated cases of this kind occurring incidentally in persons under treatment, and with the happiest results: in the acute stage, a constant current from six or eight cups, applied by means of a nasal bath, or the introduction of a nasal electrode, for one or two minutes produces decided relief; good effects are also obtained by using the induction currents over the nose and brows. In *chronic coryza*, nearly all cases may be cured by galvanic and faradic stimulation; during and after the treatment there is usually experienced a sensation of fulness in the nostrils, lasting for ten or fifteen minutes: there is also lachrymation and increased nasal secretion; these are succeeded by a perceptible improvement and very often entire relief from the frontal headache; the tumefaction of the mucous membrane is reduced and in a short time nasal respiration becomes quite satisfactory. The galvanic current should be brought in contact with the lining membrane by means of slender flexible electrodes. *Post-nasal catarrh* can also be reached in this manner and also by directing a curved electrode to the parts through the mouth. The treatment should be continued for two or three months. Patients who have been under treatment for catarrh alone, often speak of the decided improvement in their general health, and the marked freedom from their usual liability to "take cold."

Ozæna.—This is an extremely offensive discharge of sanious or puriform matter from the nostrils, and is indicative of inflammation

and sometimes of ulceration of the lining membrane of the nostrils, palate, maxillary and frontal sinuses, which, if allowed to progress, may result in caries of the bones in these situations. Sometimes hard fetid crusts accumulate, which, if large, cause excruciating pain by their presence and during their discharge. It nearly always attends syphilitic disease of these parts. When this is not the cause it will generally be found associated with a scrofulous or cancerous cachexia. Of eighty-six cases treated by Dr. Grier thirty-eight were of the mild form which follows chronic catarrh in leucophlegmatic temperaments; twenty-two were in syphilitic subjects, seven were of the tuberculous and nineteen of the scrofulous cachexia. Of these about one-half were treated by electricity only, and the others had also constitutional and local medical treatment. In five cases there were decided evidences of caries. In the cases under electrical treatment only, including those caused by catarrh, the results were very satisfactory, showing the power of the unaided current to effect cures, twenty-seven of them having thus recovered, and in the others proving it to be a very valuable addition to the usual remedies. The local treatment consisted of electrical stimulation of the parts by means of the primary and secondary induction currents, with continuous galvanism from two to six Daniell's elements. In the first two or three weeks there is not much perceptible change, except, perhaps, a diminution of the frontal pain and oppression; then the discharge begins to assume a healthier appearance, the crusts diminish in size and number, and the sense of smell, in some cases, returns. The disagreeable odor is about the last symptom to yield. The average length of treatment is from three to four months, an application being made two or three times weekly. The indication is to stimulate the diseased membranes to healthy reparative action. In nearly every case a manifest constitutional improvement was noticed with the early recuperative chances in the local affection.

The *auditory nerve* is affected by both galvanism and electromagnetism. Volta, Ritter, Remak, and others have experimented on this nerve with galvanism, and have experienced various sounds, showing its sensibility to the stimulant. Brenner, also, has recently made a number of experiments, and claims to have demonstrated that the auditory nerve answers the galvanic excitation with a certain characteristic reaction more readily than any other sensitive nerve, and that this reaction is of the utmost value for diagnosis and therapeutical purposes in the treatment of deafness. He prefers galvanism, and applies it by placing one electrode over the tragus, pressing it firmly while the other is placed on the neck, or some more distant part of the body. The normal reaction is observed on closing the circuit when the cathode is over the ear, and on opening the circuit when the anode is similarly placed. The result is generally a clear metallic sound, sometimes like the ringing of a bell, the sound of a guitar string, or of vibrating metallic plates. In order to get these effects, the change of polarity must

be effected in the metallic part of the circuit, through the commutator; there should also be a rheostat to increase or diminish the current intensity accurately and easily. The effect on the tympanic membrane is to produce intense injection, and Brenner claims having removed pathological deposits on the membrane of many years' standing; also opacities and thickening; he has also cured tinnitus aurium, catarrh, deafness, hyperæsthesia, deficient secretion of wax, etc.[1]

Deafness.—Many cases of nervous deafness may be treated with the best results by faradization of the chorda tympani. According to M. Duchenne this is best accomplished by half filling the meatus auditorius with water and introducing an insulated electrode, while the other (the positive) is placed on the nape of the neck. The slightest current should be used at the commencement, gradually increasing it as it may be found necessary. He says he has seen cases cured by this method which had resisted all other modes of treatment. Of eleven cases in which I have made such applications, three have been relieved, and of four in which tinnitus aurium was the prominent feature, one was relieved. Frank says there is no more efficacious remedy than mechanical electricity, by drawing short sparks from the ears through the electrode which has been introduced. He thinks no real aurist has obtained any good results from galvanism.[2]

Effects of Electricity on the Skin.—Sparks taken from or passed to the skin with the current from the electrical machine produce an eruption resembling lichen urticatus, surrounded by a slight redness, and accompanied by a sharp stinging sensation. Electromagnetism produces its effects, varying in accordance with the variety of current and the mode of application employed. If the skin is moist the current penetrates to the deeper tissues, producing scarcely any superficial action, unless the current is of great intensity, when it causes a burning sensation, which may be somewhat relieved by pressing firmly on the electrode. If the skin is dry and the current intense, there will be pain, redness, increased temperature, change in the bloodvessels, and contraction of the cutaneous fibre cells, as shown by the cutis anserina; the tunica dartos, the nipple, and the fibre cells of the hair roots are easily excited. These effects are most marked when produced by a dry metallic electrode, or the wire brush connected with the negative pole. The galvanic current applied to the moist skin produces redness at both poles; there is a burning sensation under both, and like the redness, is most marked under the negative, at which point may be often noticed elevations of the tissues around many of the hair follicles, and sometimes a destruction of the skin, looking like little lead-colored depressions. If we apply a dry negative electrode with a current of from eight to ten Bunsen cups, similar results appear, but much more rapidly, and with greater intensity; if the electrode terminates in a fine point and is applied to a sebaceous follicle the

[1] Galvano-therapeutics, Neftel. [2] Ohrenkrankheiten, p. 144.

contents will generally be extruded like a little thread from an eighth to half an inch in length. According to Remak, the positive pole relaxes the bloodvessels and reddens the skin; while the negative pole in five or ten minutes produces the opposite effect. It would not be unreasonable to hope for good results in the treatment by electricity of many diseases of the skin. Cases which are dependent upon nervous and constitutional causes should be subjected to the effects of galvanization of the sympathetic; in the local application we have a most powerful, and yet easily controlled means of stimulation and irritation; cutaneous anæsthesia disappears very rapidly under its influence. Dr. Picot[1] reports a case of *herpes zoster* cured by the continuous current. The positive electrode from fifteen cells was placed over the cervical vertebra, and the negative over the tract of the nerves from their roots to their terminations, for a space of six minutes each, every day for six days. I have successfully treated a number of cases of acne on the face by stimulating the affected parts with the negative pole of a primary induction circuit, placing the positive over the neck.

Galvanism of the sympathetic nerve is accomplished by placing an electrode to the fossa auriculo-maxillaris, and the other on the inferior cervical ganglion, or on the manubrium sterni, as advised by Benedikt. Meyer places one on the superior ganglion of the cervical sympathetic, and the other over the transverse process of the seventh cervical vertebra of the opposite side. These applications are generally followed by perspiration of the fingers and palm of the hand, and an elevation of the temperature of the side to which the cathode is applied. Great care should be exercised in making the application, using a current of from five to ten or twelve Daniell's cells for about half a minute. Vertigo and nausea appear, at the slightest symptoms of which the current should be withdrawn; even this should be done gradually, by sliding the electrode away, as sudden application, and especially removal of the electrodes, are capable of producing these symptoms instantly. Dr. A. D. Rockwell recommends *central galvanization*, placing the anode on the vertex and the cathode on the epigastrium, and reports the treatment in this manner and recovery of cases of melancholia, spasmodic cough, spinal irritation and congestion, cholera, etc.[2]

The power of galvanism to modify the action of the sympathetic nerves alone would render it one of the most useful therapeutic agents. It enables us, through the vaso-motor nerves, to influence the circulation and functional activity of the various organs, and hence, to modify their nutrition; it exercises a wonderful tonic influence, increases the waste and repair of the body, and relieves pain. Meyer[3] reports, as cured by this method, cases of progressive muscular atrophy, with and without swelling of the joints; neuralgias and spasms of the cerebro-spinal nerves; paralysis of the vaso-

[1] Gazette des Hôpitaux, No. 96, 1870, p. 383.
[2] N. Y. Med. Journ., May, 1873, p. 475.
[3] Med. Electricity, trans. by Hammond, p. 403.

motor nerves, primary arterial spasm, and apoplectic paralysis. Cures are also reported of epilepsy and dysmenorrhœa by galvanizing the cervical sympathetic and splanchnic nerves.

Visceral Electrization.—Most of the internal organs are accessible to electric action, either by the passage of the current through them, or by the stimulation of the nerves which regulate their vitality. In artificial respiration, the diaphragm may be excited by placing a small leather-covered metallic electrode over the phrenic nerve on each side; when the circuit is completed, inspiration occurs, the lower ribs and the abdominal walls expanding. The circuit is now broken, and pressure made on the chest and abdomen to complete expiration. A repetition of these movements will enable us to maintain artificial respiration as long as may be necessary.

In *nervous asthma*, uncomplicated with organic affections, we may either check the paroxysm, or afford great relief, and sometimes cure the patient by galvanizing the pneumogastric; this is done by placing one electrode at the auriculo-maxillary fossa and the other over the manubrium sterni; during the existence of the bronchial spasm the current should be *direct* to produce anelectrotonus of the nerve, thus diminishing its irritability. Neftel[1] suggests the possibility of a paralytic condition as also capable of producing the paroxysm, and has relieved such cases by reversing the direction producing catelectrotonus, and states that this method abolishes a majority of the attacks. Nearly all authorities agree in condemning the use of the induced current in the treatment of asthma. I have had eleven cases of pure nervous asthma in which a smooth and finely vibrating current has acted almost magically; three of them nearly always fell asleep during the application, if it was made while the paroxysm existed. The current was applied through inch-wide strips of metal on each side of the dorsal spine, while the negative pole was attached to a flexible wire cloth, covering the anterior walls of the chest; the treatment lasted about fifteen minutes, gradually increasing the intensity until it pleasantly felt, and as gradually removing it.

Drowsiness is not uncommon in anæmic and debilitated persons during the use of a generally applied direct induction current. It has occurred only under the influence of a finely-interrupted current of the second order, with a low intensity. In old persons, who are restless and sleep badly, a current of this kind passed over the forehead, while the negative is carried over the shoulders and down the arms, often and quickly promotes sound and prolonged sleep.

It would appear from two cases of *angina pectoris*, published by Duchenne, that sometimes, when independent of cardiac disease, it may be cured by electro-magnetism. This physician applied one of the poles of the battery between the shoulders, and the other to

[1] Electro-therapeutics, p. 145.

the anterior part of the chest. He also asserts that cutaneous faradization will sometimes arrest the paroxysm of nervous asthma when all other remedies have failed. Becquerel expresses incredulity in regard to this statement. Dr. A. Hewson states that in several instances he succeeded in arresting the paroxysm by means of electricity.

Often, in treating paralysis of a shoulder or arm in old people, it has occurred that a huskiness of the voice with a *chronic bronchitis* has disappeared. Since noticing this fact, Dr. Grier has used a primary induction current, fine and of low intensity, through the chest from the back and neck, stimulating the sympathetic and spinal nerves, with great benefit in such conditions; and also in the incipient stage of phthisis, relieving the dorsal tenderness and the infra-clavicular pain, quieting the irritability and lessening cough, while the expectoration has become much easier; in four cases these applications were followed by the arrest of emaciation and night-sweats.

Dyspepsia.—There is perhaps no affection in which electricity is used with better effect than in the relief of the symptomatic nervous conditions attending most cases of dyspepsia. The persistent use of the direct secondary induction current, stimulating the solar plexus, or the use of the continuous current, from four to ten Daniell's cups, from the tongue or back of the neck to the stomach, stimulating the organ itself, or the sedative effect of the current produced by a large positive sponge or plate over the epigastrium, and a medium-sized negative over the abdomen and thighs, will in many cases result in speedy and remarkable effects. Even where patients have suffered for years, and have been almost exhausted from long-continued disturbance and depression of the nervous system, good results have been manifested in a few weeks by these methods. They require to be persisted in, however, for some time after, to prevent relapse.

Galvanism of sympathetic alone is often sufficient to cure some of the most aggravated cases. Galvanism stimulates both the *œsophagus* and *stomach* to decided contraction; in the latter organ the direction is always from the cardia to the pylorus. The *small intestines* respond readily to galvanism; their contents will be propelled by the contractions towards the rectum, which, with the colon, is also easily excited, producing expulsion of their contents. Pflüger discovered that galvanism applied over the lower dorsal vertebræ to the splanchnic nerves, will arrest the movement of the small intestines immediately; this he terms their inhibitory function. Mr. Lister[1] believes this to be the effect only when the current is very strong, and that if the current is mild it will increase their functional activity.

Constipation of the bowels is a condition in which the stimulating properties of electricity render it a most valuable agent. With the induced current peristaltic movements may be excited,

[1] Proceedings of the Royal Society, vol. i., No. 32.

almost to violence, and the whole intestinal tract may be felt in motion during the action of the current. In atonic conditions of the colon it is particularly serviceable. The most direct effect is perceived when the current is passed from the tongue to the anus. The anal electrode should be well insulated where the stem portion of it comes in contact with the lower half inch of the rectum. In some cases of paraplegia, constipation is an obstinate and troublesome affection, but is usually under the control of the current. Achard, of Berlin, was the first to propose electricity for the relief of these conditions. In 1847 Dr. Dewees[1] stated that whether the torpor be associated with excessive dryness of the intestinal mucous membrane, as shown by the scybalous form of the fæces, or whether it depend upon a leucophlegmatic habit, in which the secretion of thick, tough mucus prevents the membrane from feeling the stimulus of the fæces, the action of galvanism is equally curative. In either case it augments the secretion of the intestine while urging it to propel its contents. Two years afterwards similar indications were laid down by Dr. Cummings, of Edinburgh.[2] He mentions particularly the "membranous fibrous matter" that is discharged, and advised the daily use of the electro-galvanic apparatus for the space of a quarter of an hour.

The functions of the *liver*, when torpid, may be stimulated, and the passage of *gall-stones* accelerated by electricity. The late Dr. Pepper, of this city, while professor of the theory and practice of medicine in the University, frequently recommended its use in cases of hepatic colic, and in several instances exhibited the calculi, saved by the patient, to the medical class. After stimulation of the liver, an increased flow of bile may be observed in the dejections. The treatment may be through and through the organ, and from it to the anus. When there is torpidity, the better method is to direct the current from the tongue to the region over the liver.

In suppression of the *mammary secretion*, faradization through and through the organ should be used. A rapidly interrupted, direct, primary induction current may be passed from the positive pole, over the chest, stimulating the anterior and lateral cutaneous nerves, to the gland. The nipple is extremely sensitive, and will not bear a highly intensified current. When the mammæ are painful, relief is often obtained by passing a direct, fine, secondary induction current from the glands to the abdomen and thighs. In 1855, M. Aubert reported a case in which the mother's milk dried up, the child having ceased nursing in consequence of an attack of pneumonia, but upon the daily application of the induced electro-current the secretion was restored. M. Becquerel was at first incredulous of this statement, but an opportunity occurred to him of verifying it in the case of a lady, whose milk had ceased to be secreted for eleven days. After the very first application, the

[1] N. Y. Journal, viii. 304.

[2] Lond. Med. Gaz., Dec. 1849, p. 969.

draught was felt, and by the third day the secretion had become abundant. In 1857, Dr. Hewson reported his success in three similar cases, by means of small metallic plates of silver and zinc connected by wire, which were applied in a layer of moistened sponge to either side of the breast and worn constantly for several days.[1] Fournier used the magneto-electric machine successfully to renew the secretion of milk in the breasts of a woman who had not given suck for four weeks.[2]

Spasm of the Œsophagus.—Of two cases of this kind occurring in elderly women, rendering deglutition, at times, impossible for anything save bland fluids, one was cured by the finest secondary induction current passed from the mouth to the epigastrium; the other failed to yield to any form or mode of application of the current. In the case relieved, the spasm was purely of a nervous character, caused by a highly irritable stomach, from which she had suffered for years. In the other case the cause was not ascertained. A lady advanced in years, and suffering from paralysis of the arm, resulting from a second attack of cerebral apoplexy, was also unable to swallow anything but unirritating liquids, and even they occasioned pain. Six months after the attack, at which time the case was presented for treatment, there was a nearly total loss of electro-muscular contractility. Applications were commenced by the introduction of a slender sponge-tipped spring probang, into the œsophagus; this was connected with the negative pole of the primary coil, with very slow interruptions; the positive was placed on the tongue or back of the neck. In a little while, sufficient tolerance of the electrodes was established to permit their use, carefully avoiding the lateral walls of the tube, as such a contact materially interfered with respiration, causing it to be deep and protracted, and if continued, almost amounting to apnœa. After these applications had been continued tri-weekly for two months, the difficulty had disappeared; the arm was also restored to power, and a year later she continued well. Two similar cases were treated successfully, one by the same method and the other by labile applications of the galvanic current from ten Daniell's cups. In another case the œsophageal paralysis resulted from a blow on the neck; this was treated within a few weeks of the accident by the continuous current, and resulted successfully.

Amenorrhœa.—To use Dr. Golding Bird's expression, "in electricity we possess the only direct emmenagogue with which the experience of our profession has furnished us." In young women where menstruation has not yet appeared; in those who have been chlorotic and anæmic, and where tonics have failed, after relieving these conditions to produce the flow, electricity is a most valuable remedy. When the catamenia have disappeared after cold, fright, or other disturbing causes, it is equally applicable; but where there is structural change in the ovaries or uterus it is contraindicated.

[1] Trans. Coll. Phys., Philadelphia, U. S., iii. 139.
[2] Abeille Méd., xix. 415.

A rapidly interrupted primary current, as intense as may be borne, should be passed from the sacrum to the hypogastric region, through and through the abdominal walls and from the umbilicus to the perineum. The application should be made daily during the week previous to the menstrual period. Of nineteen cases so treated by Dr. Grier, eight were relieved by the first series of applications, seven during the second, and the remainder after the third. Many cases of *dysmenorrhœa* are relieved by a fine secondary current passed from the abdomen, particularly from over the region of the ovaries down to the thighs and knees. In three cases under treatment for dyspepsia, where the menses returned every three weeks, I afterwards learned that the usual period of twenty-eight days had again been regularly established. Dr. Golding Bird used static electricity, passing ten or twelve shocks daily from the sacrum to the pubes. Dr. H. P. Dewees says of electricity, that in cases of simple obstruction or retention, it is most certain and powerful. Numerous examples of its power are given by Mr. Clark,[1] Hervieux,[2] and others.

In *uterine hemorrhage* the use of electricity appears to have been first proposed by Dr. Radford, of Manchester, and was first employed by him successfully in a case of flooding from uterine inertia during labor.[3] He applied one conductor of an electro-magnetic apparatus to the os uteri and the other to the abdominal parietes over the fundus uteri, and used both shocks and currents, to which the uterus immediately responded by contracting. Other cases of equal success have been reported by Mr. Dorrington,[4] Dr. Johnson, and Mr. Wilson,[5] so that no doubt can exist in regard to the value of electricity in these dangerous cases. Dr. H. P. Dewees employed it to restore and stimulate a patient exhausted and in danger of dying from hemorrhage after labor; it succeeded, although other remedies had entirely failed. *To excite uterine contractions*, electricity was recommended as early as 1786 by Bertholon. In 1803 Herder proposed its use in tedious labor from uterine inertia, and was followed in recommending it by Basedow, Stein, and Kilian. In 1834 Ramsbotham suggested his belief that shocks from a galvanic battery "would excite the flagging powers of the uterus under labor, and perhaps even induce action *ab initio*."[6] In 1844 Drs. Höninger and Jacobi succeeded in bringing on labor by the electro-galvanic apparatus after other means had failed, and Schreiber pointed out the advantages which it possessed over other excitors of uterine contraction.[7] In 1846 Dr. Simpson instituted some experiments with a view to determine the influence of galvanism upon uterine inertia, but, strange to say, he obtained only negative results. He concluded that it is not a means which can in any degree be relied upon for the purpose in question, and is so far practi-

[1] Graves, Clin. Med., p. 421. [2] Bull. de Thérap., xiv. 81.
[3] Ranking's Abs., vol. i., art. 113, from Prov. Med. Journ., Dec. 1844.
[4] Ibid., vol. iii., art. 82, from Prov. Med. Journ., March, 1846.
[5] Ibid., vol. iii. p. 235. [6] Lond. Med. Gaz., xiv. 87.
[7] Vierteljahrschrift für die prakt. Heilk., ii. 67.

cally useless as a stimulant to the parturient action of the uterus.[1] Nevertheless, the proof of its utility accumulated; Cleveland employed it with perfect success in uterine inertia,[2] and Radford had already suggested that it might even be competent to induce premature labor.[3] Dr. Barnes has furnished examples of its use in the induction of premature labor, in uterine inertia, in the third stage of labor, and in hemorrhage.[4] Dr. A. E. McRae[5] speaks very favorably of the effect of electro-magnetism, and advocates its use in the second stage of labor. He places one pole over the abdomen and the other on the perineum, shifting its position to accommodate the perineal changes; he uses it when the os is dilated, or dilatable; when uterine action has ceased and cannot be aroused by other stimulants; when there is post-partum flaccidity of the uterus or post-partum hemorrhage not caused by hour-glass contractions. The advantages of the remedy over ergot may be thus summarily stated: Electricity is more to be depended upon than ergot; it acts more speedily, may be more exactly proportioned to the requirements of the case, and the contractions it produces are more analogous to natural labor-pains than those of ergot, which expose the child to undue compression.[6] Dr. Garratt reports a case in which "sudden and frightful hemorrhage occurred, in a primipara, in the last months of gestation, where the placenta was attached to the cervix uteri, and it was desirable not only to stop the further loss of blood, but to bring on labor as expeditiously as possible." In this case he employed the ordinary faradaic current of full strength for half an hour in a downward direction, from the back of the neck and dorsal region to the umbilicus; then on the bowels; then over the vulva. In the mean time hemorrhage was checked. This current was maintained in this way for four hours. Labor set in regularly, and the mother was delivered of a healthy child, and did well.[7] In a case of retained placenta, where the patient had been under the influence of powdered ergot for three hours, the electro-magnetic current in less than five minutes caused uterine contraction with expulsion of blood clots and the placenta.[8]

Neuralgia, when due to structural lesions of the nerves, will only be benefited by electricity so far as it may be able to remove or modify the cause. In some cases it acts as an irritant, and increases instead of relieving the pain; but when the neuralgia is the result of exalted or morbid sensibility, or is due to rheumatism, the current becomes a most valuable remedy. Neuralgic pains are most commonly felt when the nerves are superficial, and where they emerge from bony canals; in the treatment we should ascertain these points, and make the application over them. In some instances, relief is due to the counter-irritation produced, as from that of the wire brush; in others, it results from the benumbing of the nerve

[1] Edinb. Month. Journ., July, 1846, p. 46.
[2] Lond. Med. Gaz., June, 1847.
[3] Ranking's Abs., vol. i. p. 176.
[4] Lancet, Nov. 1853, p. 456.
[5] Edinb. Med. Journ., Sept. 1873.
[6] See, also, B. Frank, Vierteljahrschrift für die prakt. Heilk., xvi. 53.
[7] Med. Elect., Garratt, p. 923.
[8] Garratt, Med. Elect., p. 931.

by the steady and prolonged use of the current; and, again, by relief from pressure of congestion, exudation, or other causes, which may result from rheumatism, exostosis, injuries, etc. In those cases where there is no apparent cause, the relief is probably due to the restoration to the nerve of its normal functions, when depressed, by the stimulation of the induction currents, or the removal of the morbid state by the catalytic effect of the galvanic current. The current should be *steadily* applied, gradually increased as the patient will bear it, and generally in a downward direction. Occasionally the relief will be almost instantaneous, and, if the case be of recent origin, may continue well. If chronic, the treatment will have to be persevered in, and even prolonged beyond apparent cure, to prevent a recurrence. If the patient is irritable and cannot bear the additional pain of treatment, we should begin with a moist application of either the induced or galvanic current, placing the anode over the painful region while the cathode is at some distance, moving about. If this fail, and the irritation can be borne, the electric moxa, or the wire brush connected with the negative pole, may be employed. In a case of hemicrania of twelve years' duration, caused by a terrible shock to the nervous system, treatment was continued by Dr. Grier for six months before permanent relief was obtained. During the year following the cure remained permanent.

A gentleman, ten years ago, had severe peritonitis following an injury in the left hypochondriac region. When treatment with electricity was commenced he stated that he had not been free from violent pain for one day since the injury. He was unable to obtain relief save while lying down with the thighs well flexed. The abdominal walls were much thickened, pasty to the touch, exceedingly sensitive, and spotted with dark-brown patches of various sizes. The direct continuous current, alternating with that of direct primary induction, was used every other day for three months, when the abdomen had become soft, elastic, of a natural thickness, and entirely free from pain. Another case, showing the value of the primary induction current, is that of a gentleman who injured one ankle while jumping. As there was not much pain at the time, he neglected it, supposing it would gradually get well. When Dr. G. first saw it the ankle measured fifteen and a half inches in diameter—six inches more than the sound limb. This was the result of exostoses of the malleoli; numerous bony points projected over the surface, almost puncturing the skin; there was constant pain along the course of the anterior and posterior tibial nerves, while the foot was at rest, and "pain all over when he walked." This was one year after the accident. The muscles were wasting, and from the knee to the foot there was intense cutaneous hyperæsthesia. The primary induction current, of slow vibrations and low intensity, was used, gradually increasing both these qualities as soon as they could be borne; the current was passed through and through the joint, and each muscle was faradized. In three months the nutrition of the limb was perfect, the pain

had ceased, and the circumference of the ankle reduced to ten and a quarter inches. During the previous winter this patient had been a martyr to frosted feet; during the treatment only the foot on the sound side was similarly affected. The application of electricity to *frost-bite* has been successful in seven cases of frozen ears treated by Dr. Grier in the winter of 1865–6; five of them were badly ulcerated. They healed rapidly, and in three of the cases seen at the close of the following winter, there had been none of the sequelæ usually present.

Anæsthesia, whether the result of an injury to the nerve or of central origin, is not amenable to peripheral applications of the current, until the removal of the cause; to remove which central galvanic treatment may be necessary. In peripheral anæsthesia resulting from external causes, such as cold, pressure, irritation, rheumatism, etc., as well as in the hysterical form, stimulation of the surface with a dry galvanic electrode, or the brush connected with the negative pole of the electro-magnetic instrument, gives very rapid and satisfactory results. Sparks from the static machine are also very beneficial.

In *hysteria* the application of the galvanic or electro-magnetic shock has sometimes arrested the paroxysm. Such a case is reported by Dr. H. L. Byrd. A young girl, twelve years of age, had a violent hysterical paroxysm every afternoon, and numerous active and severe remedies had been employed in vain, when it was determined to use the electro-magnetic battery, and apply one of the poles to the occiput and the other to the sacrum. The first application arrested the formation of a paroxysm, and prevented the return of any others.[1] A somewhat analogous case is reported by Becquerel; and one also by Dr. Meyer. These gentlemen used high tension induction currents for ten or fifteen minutes at a time. In some cases the slightest current will produce the most severe pain, while in others the most intense current scarcely seems to be noticed.

Chorea was very successfully treated with this agent by De Haen, in 1761; by Fothergill, in 1779; and more recently by Addison[2] and Golding Bird.[3] The plan of the latter was to draw sparks from the spinal column every other day for five minutes at a time, or until a papular eruption made its appearance on the skin. In thirty-five out of thirty-six cases there was either a complete cure or very marked relief. In most of them no other remedy was employed. It is worthy of remark, that the mere transmission of an electric current through the spine is quite inoperative; the passage of the sparks through the skin, and perhaps their counter-irritation of the integument, is the chief element of cure. Dr. Hughes also reports very favorably of this method. He has seen it effect a marvellous change when the body and mind were both becoming feeble under the progress of the disease and the failure

[1] Charleston Journal, iii. 412.
[2] Guy's Hosp. Rep., vol. ii., 1837, p. 493.
[3] Ibid., April, 1841, p. 84.

of other remedies.[1] Its application, however, requires caution, for in weak, nervous, and timid children, it is apt to excite alarm, and increase the agitation. This remark is peculiarly applicable to faradization. Although by its persevering employment M. Duchenne was able to cause a decided improvement in several inveterate cases of chorea, it occasioned such severe pain that the operator felt obliged to render his patients insensible by means of chloroform.[2] Benedikt met with good success in the treatment of a large number of cases by passing very slight inverse currents through the spine for one or two minutes. Meyer speaks highly of from twenty-four to thirty shocks from a battery of thirty elements. According to the same author,[3] "all those spasms are decidedly unsuitable for electric treatment which are caused by a deep disturbance of nutrition of the brain and spinal marrow, or their bony coverings (meningitis, encaphalitis, myelitis, tumors, etc.); or by plethora or congestions toward the central organs; also those reflex spasms caused by dislocations or other diseases of the uterus or ovaries, etc.; or, finally, the contractions resulting from cerebral hemiplegias, and maintained by cerebral irritation. In other forms of spasms, the judicious use of both the constant and interrupted currents renders essential service in improving general and local nutrition, and overcoming the spasms of muscles antagonistic to those which are paralyzed. Galvanization of the cervical sympathetic is sometimes sufficient to effect a cure.

Paralysis agitans, in the earliest stages, may be benefited by a direct continuous current through the spinal cord, but the cases usually present themselves when the changes in the brain and spinal cord are beyond relief of any kind.

Tetanus.—Althaus[4] quotes two cases successfully treated by Dr. Mendell, of Berlin; one was traumatic, and the other idiopathic. Dr. M. came to the following conclusions: A gentle current should be locally applied to the affected muscles; if a strong current is directed to the cord, powerful contractions are the consequence; the positive pole should be directed to the antagonists of the affected muscles. The effect seems to have been to subdue the excessive irritability of the sentient nerves.

In *scrivener's spasm*, so called, a disease in which the flexor muscles of the fore and middle fingers, and the thumb of the right hand, are affected with spasmodic twitchings and contractions whenever an attempt is made to write, some benefit appears to have been derived from electrifying the extensor muscles, or from passing a current of magnetic electricity through the arm and hand.[5]

Friedberg speaks of a man whose right hand became affected with combined paralytic and spasmodic movements, resembling those of scrivener's spasm, after the successive application of hot

[1] Guy's Hosp. Reports, Oct. 1846.
[2] Bull. de Thérap., lvii. 529.
[3] Myer's Med. Electr., Hammond, p. 349.
[4] Med. Electricity, p. 525.
[5] Lond. Med. Gaz., Dec. 1849, p. 969.

and cold water, when the hand was tired by wringing clothes, and who was gradually cured by the use of magneto-electricity.

In *infantile paralysis*, termed the essential paralysis of infants by Rilliet and Barthez, and described by Duchenne as an atrophy and fatty degeneration of the muscles, there is a decided loss of electro-muscular contractility and a marked diminution of temperature on the affected side; in cases where the atrophy is of long standing the contractility of the affected muscles has entirely disappeared and distortions are often present, resulting from the action of the antagonistic muscles. In such cases the strongest induced currents fail to produce the slightest response, and there is as little success with rapidly interrupted galvanism. The contractions which are obtained are generally produced with openings and closings of a mild galvanic current. No other form of paralysis requires more patience or perseverance, both on the part of the physician and the patients or friends than this form; the treatment may extend over a period of from six months to one or two years. The prognosis is favorable when the muscles show even the slightest response to electric stimulation. One of the earliest signs of returning health in a limb is an increase of temperature. Dr. Hammond claims to have first advised the use of galvanism as a diagnostic and therapeutic agent in this form of paralysis, and pronounces a cure impossible where the muscles fail to respond to its application.[1] According to my experience the treatment should be continued for a sufficient length of time to improve the nutrition of the muscles, if possible, before venturing upon an unfavorable diagnosis because of the absence of electro-muscular contractility. Many cases recover under electrical treatment, aided by friction, kneading, and hot applications to the limbs. After applying galvanism for three or four weeks, it is often desirable to discontinue its use for a short time; then resuming and alternating the use of the constant and interrupted galvanic currents with the induced varieties.

In *narcotism* the power of maintaining artificial respiration by means of electrical stimulation is invaluable. A child, five days old, had taken two drops of laudanum by mistake; ten hours afterwards, when the child had been pronounced beyond aid, electricity was applied to maintain respiration by the method already described, and shocks were passed from nipple to nipple, and in other directions, to thoroughly arouse it. After ten hours' unceasing exertions, the child was sufficiently recovered to be intrusted entirely to the mother. Another child, one week old, suffered from the effect of one drop of laudanum; twelve hours afterwards, electrical stimulation was determined upon, and maintained for five hours, keeping the child constantly in a state of wakefulness. This child also recovered. Another child, premature and feeble, six weeks old, was treated in the same way, under similar circumstances, and was kept living for eighteen hours, when it finally died. In the case of an adult female, it was successfully used after her medical attendant

[1] Diseases of the Nervous System, p. 691.

had tried all other means, and had declared "even *lightning* would't save her." She appeared to be quite lifeless, and was only aroused by irritating the Schneiderian membrane with a very intense secondary current. In none of these cases had the stomach-pump been used; but emetics, stimulants, belladonna, etc., had been freely administered.

In 1826, Leroy d'Etoilles performed some experiments on animals asphyxiated by submersion, showing that when the action of the diaphragm is excited by an interrupted current, respiration may be re-established and life restored.[1] Numerous examples are on record of persons restored to life after apparent death or insensibility produced by drowning, carbonic acid fumes, etc. Scholz strongly recommended this agent in *asphyxia neonatorum.* He employed it alternately with the warm bath at intervals of three or four minutes, avoiding carefully to apply too high a power, and considered it so superior to all other agencies, that, after its failure, none other could succeed.[2] As early as 1809, Mr. Babington reported the case of a person asphyxiated by charcoal fumes, but who was resuscitated by passing the charge from a galvanic apparatus through the chest.[3] More recently Mr. Farmer found that the shock of an electro-magnetic battery suddenly arrested the intoxicating effects of chloroform.[4] Friedberg restored to animation a boy who was rendered apparently lifeless by the same agent. He placed one electrode on the phrenic nerve in the neck, and the other in the seventh intercostal space. M. Duchenne, in such cases, says it should be transmitted *through* the phrenic nerves, so as to excite contractions of the diaphragm.

In *chloroform narcotism* MM. LeGros et Onimus experimented on different animals, restoring them by placing the negative pole, from thirty elements of Remak's battery, in the mouth and the positive in the rectum; they think a more powerful current would probably be needed for man.[5] Dr. Packard records the successful use of electro-magnetism, in a case of imminent danger of death from the use of chloroform.[6]

In *epilepsy*, electricity may be used as an auxiliary to the medical treatment, and sometimes with good results. The greatest good will probably be derived from the use of the galvanic current. Dr. Hammond recommends its use for about ten minutes three times a week, passing a current from ten or fifteen Daniell's cells through the brain, spinal cord, and sympathetic nerves. Althaus[7] says when the aura starts from a mucous membrane, the negative electrode should be applied to it; but where it starts from the epigastrium the positive pole answers better. As in the following case, we may ward off the attack from time to time until the paroxysms are postponed for months, instead of recurring every few days. A

[1] Archives Générales, xii. 461. [2] Meyer, Die Electricität, etc., p. 146.
[3] Med.-Chirurg. Trans., i. 83.
[4] Bost. Med. and Surg. Journ., Feb. 1855, p. 19.
[5] Brit. Med., May 16, 1868, p. 492. [6] Am. Journ., Jan. 1866, p. 154.
[7] Med. Electricity, p. 516.

gentleman, æt. 65, had been subject to epilepsy every two or three days for twenty-five years. This condition he attributed to the excessive use of tobacco; each paroxysm was preceded by the *aura epileptica*, commencing in the little finger of the left hand. He was directed, immediately on noticing the aura, to place the positive sponge on the back of the neck, and the left hand in a basin of water in which was the negative pole, thus completing the circuit of the primary induced current, finely vibrating; and until he ceased these applications, during an absence from home, he had no return of the fits. This was about thirteen weeks. During this absence, however, he died from the exhaustion following a succession of paroxysms, which, had he taken his instrument with him, might have been still further warded off. Garratt relates a case of epilepsy of a year's standing, resulting from a blow on the head; it was treated by ten-grain doses of iodide of potassium, and the continuous current from twenty-five Daniell's cups, two or three times a week. Three years after the patient remained well.[1] When it is considered necessary to subject the nervous system to the action of the current, in such cases, the constant galvanic current from the nape of the neck down the spine, will probably be productive of the most benefit.

In the treatment of *debility of the genital organs*, all the indications may be met by the proper administration of electricity. We can stimulate the sensibility of the parts, increase functional activity, relieve paralysis of the accelerator and erector muscles, and quiet morbid irritability. Of fifty-one cases, principally of long standing, and in patients ranging from thirty to fifty years of age, forty-eight were cured. Some of them had been impotent for periods varying from six to ten years.

Insanity.—According to Dr. Clifford Allbutt, of Leeds, based upon experiments made among the patients of the West Riding Asylum, electricity is of little avail as a curative agent in insanity. A marked improvement followed in acute primary dementia; a less degree of good was found in mania, atonic melancholia, and, perhaps, in recent secondary dementia; no change occurred in chronic dementia, and some cases of melancholia, and unfavorable results happened in hypochondriacal melancholia, and, perhaps, in brain wasting.[2] Althaus treated a case of loss of mental energy from imperfect cerebral nutrition by galvanizing the spine, the cerebral hemispheres, and the sympathetic, with satisfactory results.[3] He also gives cases showing the value of galvanic treatment in dipsomania and excessive spirit drinking, opium-eating, excessive smoking, and hypochondriasis.

Burns and Scalds.—As in the treatment of ulcers, electricity is equally valuable here, sometimes relieving pain almost magically, and promoting the speedy resolution of the injury. In nine cases of scalding, five were treated immediately, with relief from pain,

[1] Ganatt, Med. Electr., p. 893.
[2] Brit. and For. Med.-Chir. Rev., April, 1873, p. 341. [3] Med Electr., p. 438.

and recovery without vesication. The other four were seen some days after, and were each attended with destruction of the skin, and considerable ulceration. A few days' electrical stimulation effected all that could be desired. In a burn of the third degree, on the back of the hand, of two weeks' duration, the effect was surprising. The patient had been losing sleep for two weeks on account of the pain, and the fetid odor of the discharge. The hand was placed in a basin of tepid water, and the finely-interrupted primary induction current passed through and down the arm to the basin for about fifteen minutes; by this time the pain had ceased; for one week, daily applications were made, the water-dressing being the only one used. In ten days all was healed; the cicatrix was soft, and unlike the ordinary inodular tissue.

In the *surgical uses* of galvanism the results are mainly obtained either through its destructive action by means of the galvanic cautery, or by electrolysis. The *galvanic cautery* requires a battery capable of producing a large quantity current, with merely sufficient intensity to overcome the interposed resistances; the metallic surfaces exposed to chemical action should be larger, and the number of cups smaller than are employed in the usual form of battery. The calorimeter of Dr. Hare has been successfully used for this purpose. The Grenet battery, in which a number of carbon and zinc plates are so connected that they act as but one pair, thus giving immense surface and of course great quantity, is a very good compact form of apparatus. Perhaps the most widely known is the arrangement of Middeldorpf. Where a large amount of galvanism is made to pass through a poor conductor, an immense amount of heat is developed, and if the resistance to the passage of the current be sufficiently great, and the wire proportionately small, a white heat is easily produced and maintained. A platinum wire thus heated may be used to cauterize and divide the living tissue. Cauterization is performed by means of an electrode, the end of which is formed by a little porcelain knob, around which is wound a fine platinum wire; when the circuit is completed, the end becomes intensely heated, and not only cauterizes, but gives a brilliant light, rendering it valuable in uterine cauterization. The removal of tumors, nævi, etc., is effected by means of a fine platinum wire thrown around the part, and brought to a white heat; this platinum wire is attached to two stout, insulated copper wires, which form part of the handle of the apparatus. Among the advantages of this method may be mentioned the ease with which it can be used and prepared, the absence, generally, of pain and hemorrhage, and the tendency to early repair of the tissues, as well as the freedom from the terror inspired by the actual cautery, and its formidable preparation.

The affections to which it is adapted, and in most of which it has been used by Mitteldorpf, are these: *hemorrhage* from cavities and deep-seated parts inaccessible to ordinary instruments; *neuralgia*, by cauterizing the skin over painful portions of the nerve; *paralysis*, by the same operation near the nerves involved; *ulcers*,

which require surgical treatment; *fistulæ; strictures of the urethra;* cancerous, vascular, and other *tumors*, on the external surface of the body, of the neck of the uterus, the vagina, rectum, etc.; excision of the *uvula* and *tonsils*, of *polypi* of the nostrils, throat, auditory canal, and even of the larynx; and, finally, *amputation* of fingers, the pelvis, the clitoris, and the testicle.

Electrolysis is the term applied by Faraday to electro-chemical decomposition, and the substances thus acted upon are termed electrolytes, of which the compounds are designated as *ions;* those collecting at the positive pole are termed *anions*, and those at the negative pole *cations*. If the blood be subjected to electrolysis, either in or out of the body, decomposition takes place, and coagulation occurs at each pole. According to Althaus,[1] the negative clot is red, soft, and bulky, while the positive clot is black, hard, and small; both clots remain unchanged for several days, and are only dissolved when putrefaction of the animal liquid commences; the clots formed in arterial blood are firm, and less dark than those formed in venous blood. This coagulation is taken advantage of in the treatment of *aneurism*, by introducing one or more needles connected with one pole, into the tumor, while a flat electrode connected with the other pole is applied externally in the immediate neighborhood. Success has been obtained by the attachment of either pole to the needles, although Althaus insists upon the use of a negative needle to avoid the production of the metallic salts which would appear if the positive pole were introduced. Ciniselli[2] records the cure of an aneurism of the descending aorta in which he introduced two needles alternating their polarities, which lasted for forty minutes.

Dr. A. M. Hamilton[3] has collected ninety cases of aneurism treated by galvano-puncture, of which forty-eight were cured, while the remainder were not. In electrolysis we require a battery just the reverse of that needed in galvano-cautery. The current must be one of tension, and have little or no heating power. Before puncturing the sac, the ether spray may be used to diminish sensibility; the current, varying from five to thirty or forty cups, should be gradually introduced and withdrawn. The needles are usually corroded, and require firm and steady traction to effect their removal; the needles should be perfectly insulated where they rest in contact with the tissues. In *varicose veins* and *varicocele*, successful results are obtained by introducing the negative needle in the distended vessels, while the positive pole is placed near, on the surface. Dr. Jasche, of Nishnii-Novgorod[4], uses from four to six Daniell's elements, placing the negative pole on the tongue, and transfixing the veins, when distended by pressure, by passing the positive needle through them. The current is prolonged from five to fifteen minutes; coagulation occurs rapidly, followed by a little inflammation, which is easily subdued. The operation may have to be repeated at dif-

[1] Med. Electr., p. 275. [2] Gaz. des Hôpitaux, 1868, No. 134.
[3] Quoted by Beard and Rockwell, Med. and Surg. Elect., p. 640.
[4] Brit. and For. Med. Chir.-Rev., July, 1867, p. 277.

ferent points on account of anastomoses. In *hydrocele*, one or two needles should be passed into the tumor, and the positive electrode moved over the opposite side, using a current from ten or fifteen cells for about fifteen minutes. M. Scoutteten[1] claims to have cured hydrocele without electrolysis, promoting absorption by placing the negative pole of two ordinary Bunsen cups over the tumor for half an hour, thus removing three and a half ounces of serosity, contained in the tunica vaginalis. In *orchitis* a current from fifteen to twenty Daniell's cells should be passed through the tumor for eight or ten minutes: pain in the cord is probably best relieved by passing an *inverse* current through it, keeping the positive electrode near to but a little below the tender spot.

Many cases of *stricture of the urethra* may be cured by introducing a partially insulated electrode, until the point reaches the seat of stricture, when it may be retained ten or fifteen minutes. The other pole, generally the positive, may be placed superficially at a short distance, using a very mild current. There is generally some irritation experienced during the first micturition, after which it subsides, and considerable relief is experienced. *Goitre* has been successfully treated both by the use of the needles, and by external application of the current. Hydatid tumors of the liver, lipoma, nævi, and epithelioma have also been satisfactorily treated in this manner.

Of the other medical uses of galvanic and magnetic electricity the following may be mentioned. A young lady had run a cambric *needle* into her knee. Dr. Gill, of New York, whose assistance was requested, bound a horseshoe magnet over the part so as to charge the needle by induction. Afterwards, when a magnetic needle was brought near, its deviation and dip showed the position and direction of the needle in the flesh. Its north and south poles having been marked, a line drawn between them represented the position of the lost needle. An incision was made accordingly, and the needle, so ingeniously discovered, was extracted.[2]

In 1847, Dr. Dewees wrote that he believed he had succeeded, by means of galvanic plates, in *extracting mercury* from a patient who had been using this medicine.[3] Since then Dr. Huff, of Lexington, Kentucky, and MM. Vergnies and Poey, of Paris, claimed to have removed mercury, and also lead, from the system by subjecting the patient to a galvanic current while he was insulated in an acidulated bath.[4] The method does not appear to have been applied further.

It has also been proposed by Orioli, Harle, Prevost and Dumas, and others, to employ galvanism for procuring the disintegration of *stone in the bladder*. But no practical results of importance have yet been obtained. Dr. Bence Jones, after experiments with the galvanic current, thinks that a solution of the nitrate of potash is the

[1] Gazette Medicale, Aug. 22, 1868.
[2] Am. Journ. of Med. Sci., Jan. 1847, p. 263.
[3] New York Journ., May, 1857, p. 307.
[4] Phil. Med. Exam., Aug. 1855, p. 507.

least harmful and yet the most active of the fluids to be thrown into the bladder during the attempt to dissolve the stone.

An electrical *bullet-probe* has been constructed, so that when the point touches the imbedded metal, the circuit is completed between the two metallic points at the end of the probe, and a bell is rung by means of an electro-magnet included in the circuit.

The *electric light* has been proposed as a means of illuminating the cavities of the body, by introducing glass tubes containing twisted wires, which are acted upon by the electrical machine of Middeldorf. At the international medical congress held in Paris, M. Milliot demonstrated its possibility and utility upon the bodies of a dog and cat.

Gunshot *wounds* and other *injuries of nerves*, have been made the subject of special study by Drs. Mitchell, Morehouse, and Keen, of this city; in speaking of the treatment, they allude to electricity as one of the most valuable of the remedial agents. The indications to be fulfilled by it are pointed out in the statement, that "when a nerve has been cut across, the muscles to which it is distributed undergo one or more of the following changes: Paralysis as to will; loss of tone; loss of electro-muscular contractility; loss of electro-muscular sensibility; atrophy and possibly contraction." Here we have conditions, for the treatment of which general rules have already been given. Dr. Mitchell's results were obtained by faradization, and the use of the Duchenne instrument. He says: "Now let us suppose months to have passed, and that the nerve has undergone partial restoration. We faradize the limb daily, or thrice a week. Some of the muscles make no response in any shape; their neural connections are not remade. Others after a time begin to fill up, tone returns, the vessels enlarge, the skin flushes, and at last electric contractility and sensibility come back by small degrees to some, and rapidly and fully to others. These muscles we shall cure in time. If the limb now begins to suffer from neuralgia, it is also a favorable sign, but may call for a temporary suspension of treatment."

In many muscles, voluntary motion is recovered without the slightest exhibition of electro-muscular contractility. Nevertheless, electricity seems to be as efficient in these as in other cases. In every instance the use of the battery must be prolonged for months after the return of partial voluntary control, although, of course, this is itself a great aid to further treatment. "In the variety of partial wasting, the course and duration do not differ from the more general form, unless repair of the special nerves implicated should follow. This may occur, however, without the diseased muscle regaining its size. But if, under such circumstances, electricity be locally used, repair is often speedy, and is preceded by certain changes in the electric manifestations to be hereafter described. Of this we are distinctly sure, that there is no test of the restoration of nerve supply, except the electric current, and that without its employment a cure is often hopeless, when the atrophy is well marked, no matter how perfectly the

nervous communication may have been restored." Electricity in the atrophy of the muscles is "not contraindicated, where there are also organic contractions." "Each sitting should be about ten or fifteen minutes, daily, and each muscle faradized in turn, remembering that the treatment of atrophied muscles is an affair of months or even of years. In the relief of cutaneous anæsthesia, the wire brush is used with most excellent effects."

The aid rendered by electricity in the diagnosis and prognosis of injuries to nerves is carefully pointed out, and is illustrated by well marked cases, in the work[1] from which these observations have been taken.

OXYGEN.

History.—The first of August, 1774, Priestley discovered oxygen, and thus laid the foundation of modern chemical science. Its power of supporting combustion appeared to be its most remarkable quality, and it was not until the following years that the fact of its being, through the function of respiration, essential to life, was recognized by him. Immediately thereafter the idea of its being in a special sense "vital air," and of its therefore constituting a panacea for all diseases, took possession of the mind of Priestley, as well as of Fourcroy and others in France, whose knowledge did not fit them to decide so grave and purely medical a question. From these philosophers the notion of what a remedy for disease oxygen ought to be spread to the medical profession, and very soon proofs abounded of its extraordinary virtues. Nevertheless, it soon appeared that the very disease in which, according to these unprofessional judges, it should have pre-eminently displayed its power, consumption of the lungs, was aggravated by it and the fatal issue hastened. The views, also, which Beddoes published in 1789, were less the judgments of a physician than the conclusions of a chemist, for he was professor of chemistry in the University of Oxford. The diseases in which he employed oxygen were asthma and chlorosis, and in thus restricting its use he displayed more judgment than his predecessors. Here and there, now and again the medicinal virtues of oxygen were attempted to be revived, but the erroneous grounds upon which its claims were originally urged now failed to support them, and with the exceptions referred to, nothing more was heard of the subject until the lapse of nearly seventy years had caused them to be totally forgotten by all who were not interested in preserving a record of human delusions. In 1857, a London physician, Dr. Birch, published a work, of which a second edition appeared in 1868, and which set forth the renovating power of oxygen in various cachexiæ, and attributed to it almost miraculous virtues, which were duly attested by clinical evidence,

[1] Gunshot Wounds and other Injuries of Nerves. Drs. Mitchell, Morehouse, and Keen, Philadelphia.

and by reasoning on the *modus operandi* of the gas of so unscientific and even irrational a character as to suggest doubts as to the validity of the facts themselves. In 1866, Demarquay, in his work entitled *Pneumatologie Médicale*, presented at length the history of the medical employment of oxygen, and numerous physiological and clinical observations respecting its action and uses, without, however, assuming to pronounce definitively upon its power to cure. Oxygen, in the form of peroxide of hydrogen, was discovered by Thénard in 1818; but its medicinal properties were not systematically investigated until the task was undertaken by Dr. B. W. Richardson, who published the results in 1868.[1]

Preparation.—The purest oxygen is prepared most conveniently by heating chlorate of potassa mixed with a small proportion of peroxide of manganese in a retort. The resulting gas should be thoroughly washed before being used for inhalation. It may be kept in a gasometer over water, or compressed in iron bottles. When respired it is contained in large rubber bags furnished with appropriate tubes and mouth-pieces.

Peroxide, or deutoxide, of hydrogen is procured in the manner originally proposed by Thénard, as follows: "When peroxide of potassium, sodium, barium, strontium, or calcium is digested in any hydrated acid which forms a soluble salt with the salifiable base resulting from the decompositon of the peroxide, the excess of oxygen does not escape as gas, but passes over to a portion of the water and converts it into peroxide of hydrogen." On adding peroxide of barium to a solution of hydrochloric acid in distilled water, the peroxide is converted into the soluble chloride of barium, and the water becomes charged with peroxide of hydrogen. The salt of barium is then removed by dilute sulphuric acid, leaving a solution of peroxide of hydrogen containing the freed hydrochloric acid. By repeating this process the water may be charged with thirty volumes of oxygen, and the hydrochloric acid removed from it by precipitation with chloride of silver, and filtration. Peroxide of hydrogen in watery solution has a faint odor like that of chlorine, and a caustic taste; when concentrated it whitens the mucous membrane. It mixes with water in all proportions; is not affected by light; freezes at —30°; and is evolved by heat.

Action. *On Animals.*—The experiments of Priestley and his contemporaries showed that animals lived longer in an atmosphere containing an excess of oxygen than they do in common air. On the other hand, it became equally clear that the prolonged use of such an atmosphere was deleterious. On introducing an animal into a receiver containing oxygen, Fourcroy observed that respiration became deeper, the pulse beat more rapidly and forcibly than natural, and very soon a true febrile condition was induced. The eyes grew red and prominent, sweat poured from every part of the body, whose temperature was singularly elevated, and at last an acute inflammatory fever ensued ending in gangrene and a conges-

[1] Times and Gaz., Dec. 1868, p. 661.

tion of which the chest was the principal seat. Demarquay[1] performed some experiments on animals to determine the influence of inspired oxygen upon the condition of wounds, and he found that uniformly the raw surface of the wounds exhibited an increased capillary injection, an augmented exudation of plastic lymph, and ultimately an engorgement which resulted in ecchymoses. Meanwhile the amount of blood in the vessels appeared to have become greater, but the venous blood did not change color, nor was the temperature sensibly modified. Other experiments appeared to show that animals, long confined in oxygen, grow feeble and perish. Dr. Andrew H. Smith,[2] who performed similar experiments, taking the precaution to remove the carbonic acid as fast as it was exhaled during respiration, found, on the other hand, that the tissues presented no unusual appearance, whence he concluded that the color in question does not depend upon hyperoxygenation alone, but also "upon a coincident retention of carbonic acid in the tissues." He further concluded that when the precautions alluded to are used, oxygen does not exert any deleterious action upon animal life; and, even more, that no larger quantity can be taken up by the blood than it is capable, under favorable circumstances, of absorbing from the atmosphere. So far as these last experiments go they would seem to qualify, indeed to positively limit, any therapeutical value which may be claimed for oxygen beyond that which is possessed by atmospheric air.

On Man.—Demarquay describes as follows the effects of inhaling oxygen gas: "The first inspirations sometimes occasion a slight sense of warmth in the mouth, a sensation rather agreeable than otherwise, and which extends to the larynx and bronchia. This warmth may also be felt in the abdomen. The pulse increases in frequency by as much, sometimes, as twenty pulsations in a minute, and grows more tense; but this effect is transient. Sometimes, indeed, the pulse is rendered less rather than more frequent. There may be a sense of a certain degree of exhilaration, a tingling of the fingers, or a desire to use muscular exertion, and some tightness about the head. The inhalation is also said to stimulate the appetite, and to diminish the proportion of urea, of uric acid, and of coloring matter in the urine." Dr. B. W. Richardson has called attention to several conditions which modify materially the action of oxygen. One of these is that neutral oxygen will not combine with the carbon of the blood unless it be diluted, and that the degree of dilution most favorable to this action is precisely that which exists in atmospheric air; nevertheless it is still absorbed when inhaled in a mixture of three parts of oxygen to two of nitrogen. Beyond this proportion it is not absorbed, and hence animals die in the gas when it approaches a pure state, not by a narcotic process, but by a process of negation, or apnœa. Dr. Richardson also showed that within certain limits the blood absorbs more

[1] Essai de Pneumatologie, Paris, 1866.
[2] New York Med. Journ., xi. 130.

oxygen when it is less dense than natural; and, further, the important fact that pure and freshly made oxygen is absorbed in a much larger proportion than such as has been in contact with organic emanations, and that when thus largely adulterated it no longer combines with the blood.[1] Supposing these observations to be accurate, it follows that in different conditions of the system and especially of the blood, the absorption of the gas will greatly vary, and its effects, even when absorbed, will be dissimilar.

Uses. *Pulmonary Phthisis.*—Chaptal, in speaking of the effects of oxygen in consumption, and after describing its failure to save the victims of the disease, said: "Even its enlivening and hope-inspiring influence renders it a precious remedy, for it scatters flowers on the threshold of the tomb, and veils the terrors of this fearful road." Dumas denounced its use in active phthisis as tending to irritate, inflame, and ulcerate the lungs. Fourcroy, also, noted that a certain degree of improvement which at first followed its use, was succeeded by violent inflammatory phenomena which hurried the disease to a fatal termination. These results, and probably general experience of a similar kind, condemned the remedy to oblivion for eighty years, when it was once more put forward as a cure for pulmonary consumption upon the strength of certain favorable reports of its efficacy. When these are examined they are far from convincing; for one reporter (Birch) asserts that in a certain case with a tuberculous cavity "the flattening of the chest gave way to almost perfect symmetry;" and the cases cited or reported by Demarquay do little more than exhibit a palliation of certain of the symptoms of the disease. Later, and more numerous as well as more accurate, observations authorize a somewhat more favorable estimate of the treatment of phthisis by oxygen. In 1866 Dr. F. Bricheteau pointed out the conditions for using the remedy beneficially to be the absence of fever and nervous excitability, an early stage of development in lymphatic and scrofulous patients, a slight degree of local change, progressive emaciation, dyspepsia, etc.[2] In the same year Beigel pointed out the *modus operandi* of the gas to be its supplying through the lessened respiratory surface of the diseased lung as much as, or more oxygen than would be inspired in health, and thus delaying the mischief which the system must suffer through an imperfect supply of oxygen and a diminished decarbonization of the blood.[3] In 1869 Mr. Edward Mackey employed a mixture for inhalation of one part of oxygen to from ten to five parts of atmospheric air. Its effects were to subdue or remove the cough and the active physical signs of pulmonary disease, as well as to increase the strength and weight of the patients.[4] In 1869 ten cases were reported by Dr. C. E. Hackley; of these, six patients, during the oxygen treatment, gained in the aggregate 49½ lbs. of weight, and four lost seven pounds.[5] Soon afterwards Dr. A. H. Smith published three cases

[1] Lancet, Sept. 1864, p. 341.
[2] Bull. de Thérap, lxx. 162.
[3] On Inhalation, p. 69.
[4] Practitioner, ii. 278.
[5] New York Med. Journ., ix. 597.

in all of which the use of the gas was followed by an amelioration of the symptoms, in one case by a return of suspended menses, and by a decided gain in flesh and strength.[1] Dr. Read reports two cases of equally striking effects from the treatment,[2] and subsequently ten or twelve more, which appear to have been cases of pulmonary phthisis, of which the greater number were permanently benefited by the treatment.[3] In nearly all the reports from which the above summary is condensed, it is stated that the ordinary methods had been employed before resorting to the inhalation of oxygen, but without any beneficial influence upon the course of the disease, and also that these methods, especially the administration of cod-liver oil, were continued while the oxygen inhalations were employed. This fact is important, for it has been observed that consumptive patients who were unable to retain and digest cod-liver oil when debarred from exercise in the open air, regained the ability to do so after the oxygen treatment had been instituted; and therefore it may very well be supposed that the benefit derived from the inhalation of oxygen consisted less in a direct influence upon the pulmonary disease, than in the indirect advantage which the gas conferred of promoting the digestion of the oil.

Affections of the Bronchia.—The inhalation of oxygen appears to be a useful adjuvant in the treatment of *emphysema* of the lungs, and of chronic bronchitis, rendering the respiration easier, the expectoration freer, and therefore the cough less harassing. According to Beigel, it is possible in this manner to lessen the distension of an emphysematous lung, as shown by the progressive contraction of the distended chest. But even were the relief of *asthmatic paroxysms* the only benefit derived from the method (and this appears incontestable), its value would still be great. It was in this affection that, according to Beddoes, the virtues of oxygen were most conspicuous. Out of 22 cases he states that ten were cured, and nine relieved; a result which is open to more than criticism. Demarquay mentions a case, probably of nervous asthma, in which its effects were "wonderful;" and Paul, one complicated with emphysema which was immediately relieved by it;[4] and Dr. A. H. Smith refers to several others in which the effects were equally prompt and satisfactory. In *bronchitis*, especially of the smaller tubes, a disease in which distress in breathing may reach its highest degree, the free supply of oxygen must necessarily palliate the dyspnœa, and in this manner prevent that congestion of the lungs, heart, and brain which tends constantly to increase, and to extinguish life. A very striking example of its power to save life, even *in extremis*, is presented by the case of a child of two and a half years old, to whom it was administered when all other means had totally failed to give relief.[5] Beigel relates a case of *membranous croup*, in the course of which a state of asphyxia was already far advanced when

[1] New York Med. Journ., xi. 152.
[2] Ibid., xiii. 165.
[3] Ibid., xiv. 382.
[4] Bull. de Thérap., lxxv. 104.
[5] Med. Record, iv. 171.

it was relieved by oxygen inhalations; and Dr. A. H. Smith one in which they distinctly palliated a similar condition in *diphtheria;* but the cases of such affections in which the remedy has been used are not numerous enough to warrant a definitive estimate of its value in their treatment. *Asphyxia* from various causes is reported as having been relieved by these means. Paul relates a case of this condition in a pregnant woman who had eaten to repletion, was cyanotic and pulseless, but after inhaling thirty "*litres*" of the gas she gradually recovered; and another in which *opiate narcotism* existed and was promptly dissipated by the same means. In a third case the same remedy saved the life of a man asphyxiated by the vapors of charcoal;[1] and in a fourth in which asphyxia was produced by an attempted suicide, the action of oxygen was equally prompt and efficient, although the case was complicated with congestion of the lungs.[2] A curious case is furnished by Linas of what may be regarded as slow poisoning by the same vapors. A woman having continued, night after night, to warm her small chamber with an open vessel in which charcoal was burning, its intoxicating fumes at last nearly destroyed her life, but she was saved by timely succor. For a week or more afterwards she was cyanotic, her temperature was abnormally low, and her general sensibility as well as the special senses were blunted. She complained of headache, buzzing in the ears, vertigo, debility, sleepiness, epigastric and præcordial distress, nausea, vomiting, and constipation. The usual methods of treatment were resorted to without relief, when oxygen inhalations were employed, which immediately ameliorated the symptoms, and they thenceforth declined until a perfect restoration of the patient to health took place.[3]

To the same category of cases belongs that of a young man who was suffocated by the fumes proceeding from an explosion of gunpowder (?). The symptoms were, at all events, those of profound asphyxia, except so far as loss of consciousness was concerned, although there was a tendency to somnolence. The skin was cyanosed, the lungs congested, and filled with fine dry râles, but after every application of the gas these symptoms improved, but finally, at the end of five weeks, death by broncho-pneumonia took place.[4] Two cases are recorded of poisoning by *illuminating gas* which owed their recovery apparently to oxygen.[5]

Dr. C. Paul[6] writes as follows: "In 1847 Dr. Jackson, of Philadelphia, suggested the administration of oxygen in asphyxia from ether. He was imitated by Blanchet, Faivre, Gianetti, and Martin-St. Ange, and particularly by Duroy and Ozanam." Duroy showed that oxygen inhaled along with chloroform, delays and diminishes its anæsthetic action; and administered after chloroform anæsthesia has set in, it arrests this process. It does not therefore follow, says M. Paul, that the poisonous effects of chloroform would be neutral-

[1] Bull. de Thérap., lxxv. 102.
[2] Bull. et Mém. de la Soc. de Thérap., ii. 138.
[3] Bull. de Thérap., lxxvi. 519.
[4] Bull. et Mém., etc., p. 140.
[5] Bull. de Thérap., lxxvi. 517.
[6] Ibid., lxxv. 104.

ized by this gas, but a case which occurred in New York appears to prove that this conclusion is perhaps too absolute. A young man having inhaled chloroform became "asphyxiated" and all hopes of his resuscitation had been abandoned, when oxygen was proposed and applied. In a few minutes the patient "arose and placed himself upon a chair."[1] It can hardly be admitted that this case was one of chloroform poisoning.

Asphyxia from *drowning* has been removed, even in desperate circumstances, by this remedy;[2] that also occasioned by the pressure of *enlarged bronchial glands;* and the similar condition due to obstructive *heart-disease* has been palliated by such inhalations.[3]

Anæmia and *Chlorosis* are reputed to have been cured by means of oxygen;[4] but in the reported cases a larger share of merit seems to be due to the iron which was simultaneously used.

Diabetes.—The great utility of active exercise in this disease is recognized by all who have employed it, and there would seem, therefore, to be a probability that one, at least, of the elements concerned in this influence may be the increased respiration of oxygen which it involves. According to Demarquay, oxygen inhalations cause a marked diminution of sugar, even to the extent of one-half, in the urine of diabetic patients, especially when an alkaline medication pursued at the same time tends to fix the oxygen in the blood and to destroy the excess of sugar which it contains. Assuredly, this treatment, which has been chemically proved to produce a marked and rapid decline of the proportion of sugar in the urine, and therefore of its density, only controls a symptom of the disease without affecting its essence,[5] yet as that symptom is a principal cause of the decline of flesh and strength in diabetes, the treatment by oxygen, where it proves successful, becomes a potent means of prolonging life in this disease. A striking example of the success of peroxide of hydrogen has been published by Dr. Bayfield,[6] and another by Dr. Day, which, indeed, suggested its trial in the case just cited;[7] but Dr. B. W. Richardson, who studied the operation of the medicine in two cases of diabetes, found decided advantage from it in one only, and concluded that "at this moment there is no proof that peroxide of hydrogen is of specific value in the treatment of diabetes."[8] Dr. Pavy, also, who tried it in a few cases, "was unable to trace the production of the slightest effect either one way or the other."[9] It is not impossible that peroxide of hydrogen, a liquid given by the stomach, may not have the same action as oxygen gas directly taken into the blood through the lungs.

Among other diseases for the cure of which oxygen has been administered may be mentioned, *neuralgia*, *diphtheritic paralysis*,

[1] Ranking's Abstract, xvii. 118.
[2] New York Med. Journ., xii. 165.
[3] Amer. Med. Times, i. 346.
[4] N. York Med. Journ., x. 480; Practitioner, ii. 282.
[5] Vid. Cases of Berenger-Férand, Bull. de Thérap., lxvii. 217.
[6] Times and Gaz., Oct. 1868, p. 464.
[7] Ibid., p. 482.
[8] Ibid., Dec. 1868, p. 663.
[9] On Diabetes, 2d ed., p. 268.

albuminuria, *chronic gout*, and *pneumonia ;* but the facts concerning them are too scanty to call for a more detailed account. In the form of peroxide of hydrogen, oxygen is of marked benefit in some stages of *syphilis*, according to Dr. Richardson.[1] Administered in large doses it acts very much like mercury, and salivation may be induced; but its influence is not persistent. In moderate doses it acts more like iodide of potassium. So that it may prove a valuable adjunct both to mercury and to iodide of potassium, to the former in the earlier, and to the latter in the later stages of syphilis.

Administration.—Oxygen gas is usually administered by causing the patient to inhale it from a large caoutchouc bag which is provided with a tube and mouth-piece. The tube is also furnished with a cock which is opened while the patient inspires, and closed when he expires. The gas is generally inhaled pure, the air which enters through the nostrils sufficing to dilute it in the lungs. But sometimes it is mixed with atmospheric air in the bag or gasometer in the proportion of one part to three or four of air, in which case the nostrils of the patient are closed during inspiration. The quantity administered is usually one or two gallons daily, or twice a day; but in cases of asphyxia and similar conditions, the dose must be regulated by the effects which are produced. In such cases the gas should not be diluted.

The solution of the peroxide of hydrogen containing ten volumes of oxygen is the best for medicinal use. It may be given at first in doses of from one drachm to four, and afterwards increased to six drachms or even an ounce. To deprive it of its caustic, metallic taste the liquid should be freely diluted with water.

VINUM PORTENSE.—Port Wine.

VINUM XERICUM.—Sherry Wine.

History.—The earlier notices of wine are contained in the account of Noah's drunkenness (B. C. 2500), in the history of Lot's unnatural crime, and in the dying prophecy made by the patriarch Jacob (B. C. 1700).[2] Both in sacred and profane writings it is frequently associated with oil in the descriptions given of different countries as an emblem of their fertility and wealth. On the other hand, the books of Scripture, especially the writings of Solomon, abound in pictures of the calamities that attend the intemperate use of wine and strong drink. No modern experience or ingenuity has painted in darker colors or more hideous forms the consequences of intoxication. The Greeks and Romans employed wine both as a common drink and as a medicine. Among the former people, the wines of Cyprus, Lesbos, and Chio were much celebrated, and as all readers of Horace will remember, the Chian wine was held

[1] Times and Gaz., Dec. 1868, p. 695.
[2] Genesis ix. 51; xix. 35; xlix. 11.

in high esteem. The prevailing quality of this, as well as of the other wines just mentioned, was sweetness and a delicious flavor. The wines of Corcyra and of Mende were remarkable for their good qualities; those also of Naxos and Thasos, though generally considered inferior to Chian wines, were compared to nectar.[1] These wines were very strong, and were generally drunk diluted.

> "Such was the wine—to quench whose fervent stream,
> Scarce twenty measures from the living stream
> To cool one cup sufficed."—ODYSSEY, b. ix.

The ancients were extremely careful to adapt the quality of wine to the varying conditions of the system. There is hardly any disease in which it was not used under one or another form, and the properties of each variety were carefully described by the medical writers of Greece and Rome. The tendency of new wine to derange the digestion, promote urination, and disturb the sleep; of must, or unfermented wine, to produce colic, flatulence, and diarrhœa; of sweet wine, as well as new, to impair digestion and produce headache;—these and many other qualities, both good and evil, were ascribed to different varieties of this intoxicating liquor. Galen, also, enumerates very fully the properties of a great number of Italian, Greek, and Asiatic wines, but he, like previous authors, dwells more upon their evil than their good effects when used habitually. Still earlier, indeed, Hippocrates had expressly referred to the muscular debility which results from the habit of indulging in wine. He also points out the dangers of abandoning it too suddenly.[2] Among its medical uses the writer last named refers to its efficacy in various cases of narcotic poisoning (by conium, opium, aconite, mushrooms, etc.), and describes it as an antidote to the bites of venomous serpents and insects. He directs it in the cold stage of fevers, to counteract hypercatharsis, and to relieve flatulence. He prescribes white wine as a diuretic in calculous affections, and directs pledgets of wool moistened with wine as an application to wounds and inflammations, and to phagedenic and other unhealthy sores. While admitting the diuretic and nervine qualities of old white wines, he does not fail to notice their tendency to produce headache. The medicinal uses of wine enumerated by Pliny are limited to certain symptoms rather than diseases; he mentions many conditions in which it is contraindicated, and very few in which it is beneficial. Of the latter, the *morbus cardiacorum*, supposed to be the sweating sickness, is one, and of it he says that the only hope of its cure is in wine.[3] Rhazes, among the Arabian authors, furnishes an ample account of this subject. Besides grape wine, he mentions wines prepared from raisins, honey,

[1] MOREWOOD, An Essay, etc., on Inebriating Liquors (Lond. 1854), p. 20. Compare, also, PLINY, Hist. Nat., lib. xiv., where the whole subject is treated of in detail.

[2] STRUMPF, Handbuch, i. 951.

[3] Lib. xxii. cap. xxv. An account of the varieties of ancient wine and of their effects may be found in DIOSCORIDES, lib. v. cap. vii.; and in ADAMS's Comment. on PAULUS ÆGINETA, i. 172.

dates, figs, sugar, barley, wheat, and the juice of sweet fruits, from the cocoa, pomegranate, etc., but speaks of them as being all more unwholesome than the first named. Of the advantages of wine used in moderation, he remarks that it improves the nutrition and the complexion, promotes the excretions, and particularly the urine, renders the sleep sound and refreshing, and quickens the mental faculties. But if the bounds of sobriety are often overstepped until the speech grows thick, the mind confused, and the gait staggering, the result is very mischievous—for the body becomes feverish and relaxed, and all the matters which ought to be excreted are retained. Wine ought not to be habitually drunken, but only at intervals of several days; and as for intoxication, its repetition brings on disease, headache, paralysis, shaking palsy, and acute affections. Inflammation of the viscera, and especially of the liver ensues, with boils, abscesses, mental weakness, epilepsy, apoplexy, dulness of the senses, inflammation of the eyes, muscular debility, emaciation and inappetence, asthma and palpitation of the heart. Rhazes recommends emetics as a remedy for the nausea and headache following a debauch, and advises rest with the use of acid syrups diluted with water or barley water. The more important consequences alluded to, he says, are to be cured by abstaining for a long time from wine, or, still better, by never drinking any more of it.[1]

Description.—Wine is the fermented juice of the grape, the fruit of *Vitis vinifera*. Of this plant several thousand varieties exist, which are distinguished by their foliage, or more particularly by the size, form, etc. of the clusters, and by the size, form, color, perfume, taste, consistence, etc. of the berries. The varieties appear to depend upon differences of climate, soil, and culture. In the vine-growing countries of the Eastern continent it is cultivated in the open air. These countries chiefly lie between the latitudes of 25° and 52° N., extending from Shiraz, in Persia, to Coblentz on the Rhine. In the United States, the northern limit of the vine cultivated in the open air is not higher than 42° N., and Cincinnati, in lat. 39° N., was the only place, until recently, where an extensive manufacture of wine was carried on. The vineyards of California, enjoying a milder and more equable climate, are still more productive, and furnish already a very large quantity of light and well-flavored wines. Native varieties alone have thus far proved successful, and there is reason to believe that nothing but skill and perseverance are wanting to render this one of the wine-producing countries of the world, and by that means, more than any other, to diminish its national vice of intemperance.

The qualities of wine depend in a great degree upon the climate in which it is produced, and yet extremely slight differences of soil, or of exposure to the sun, occasion remarkable variations in the character of wines raised within a few hundred yards of one another.

[1] Ebn Baithar, ed. Sontheimer, i. 386; ii. 548.

The chief wine-producing countries are France, Germany, Portugal, Spain, Italy, the Canary Islands, and the Cape of Good Hope. The wines of France are popularly known in this country as claret and champagne, of Germany as hock, of Portugal as port, of Madeira, the Canaries, and the Cape of Good Hope as Madeira wine, and of Spain as sherry. More correct designations of the principal varieties are as follows:—

German Wines.—1. *Rhenish.* The best are white. The *Riesling* wines are distinguished for a singularly delicate, delicious, and refreshing flavor, and a peculiar bouquet. They are very highly prized in many nervous diseases. The *Orleans* wines are stronger, and without the aroma of the preceding. To these varieties belong Rüdisheimer, Johannisberger, Hattenheimer, Marcobrunner, Steinberger, Hochheimer, Leibfrauenmilch, Niersteiner, etc. 2. *Main* wines. Of these the Steinwein is best known abroad. 3. *Pfälzer* (Palatinate) wines: Deidesheimer, etc. 4. *Moselle* wines: Braunenberg, etc. 5. *Aar* wines. 6. *Neckar* wines. 7. *Margrave* wines. 8. *Baden* wines. 9. *Bohemian* wines: Melnecker. 10. *Hungarian* wines: *white*—Oedenberger; *red*—Ofener, Erlauer, Tokay.[1]

French Wines.—1. *Champagne* furnishes both white and red wines; the former, which are known everywhere, and everywhere imitated, are distinguished for their sparkling effervescence or their agreeable flavor. Of these, the most celebrated brands are Sillery, Ay, Dizy, Epernay, etc. Of the red varieties the most approved are Verzy, Verzenay, Bouzy, St. Thierry, etc. 2. The wines of *Burgundy* are famous for their brilliant color, agreeable and delicate flavor, their agreeable perfume, and their stimulating properties. The most celebrated vintages of red wine are Romanée Conti, Clos Vougeot, Chambertin, St. George's, Volnay, Pommard, and Beaune. Of the white varieties those best known are Chablis and Pouilly. 3. The *Bordeaux* red wines are celebrated for their marked but agreeable perfume and slight astringency. The finest are produced in the vineyards of Château-Lafitte, Château-Latour, Château-Margaux, Haut-Brion, St. Julien, St. Estephe, St. Emilion, La Rose, Léoville, etc. The best white *varieties* are Bommes, Rions, Grave, Sauterne, Barsac, etc. 4. The Hermitage in Dauphiny, the Côte Rotie in the Lyonnais, and in Languedoc the spirituous and cordial muscat wines of Frontignan and Lunel are the most celebrated.[2]

Spanish Wines.—Malaga, Tinto de Rota, Alicant, Sherry, Tintilla, etc., which are all strong-bodied wines.

Portuguese Wines.—*White:* Bucellas. *Red:* Port wine, etc.

Italian Wines.—Albano, Monte Fiascone, Orvietto, Lachrymæ Christi, Alliatico, Marsala, etc.

African Wines.—Madeira, Teneriffe, Constantia.

American Wines.—Catawba, California Hock, Muscatel, Angelica, and Port are the most abundant and the best known.

[1] Strumpf, op. cit., i. 953.
[2] Chevallier, Dictionnaire, etc. des Substances Alimentaires, ii. 493.

The varieties of wines are so numerous that it is very difficult to classify them; but the following arrangement, based upon their chief constituent parts and the dependent effects, has been proposed by Mitscherlich,[1] and is perhaps the most satisfactory:—

1. Wines containing a large proportion of alcohol, and which produce the effects of alcohol in a marked degree: the spirituous wines.

2. Wines containing but little alcohol, with tannic acid and red coloring matter, which are less stimulant than tonic: the lighter red wines.

3. Wines containing little alcohol, but a large proportion of saline and acid ingredients, which, of all wines, are least excitant to the circulation, but readily derange the digestion: the lighter Rhenish and Moselle wines.

4. Wines containing little alcohol, but much carbonic acid, and which speedily develop the effects of these constituents: the sparkling wines—champagne, etc.

That such a classification is, however, extremely imperfect and insufficent, particularly in considering wine as a medicinal agent, is made apparent when we observe the wonderful variety of constituents which chemistry has discovered in the juice of the grape, as will be shown in a succeeding paragraph.

Manufacture of Wine.—The juice of the grape (*must*) is obtained by the wine-press, by various other mechanical contrivances, or by simply treading the grapes with the feet covered with heavy wooden shoes. As soon as the expression is complete, the skins are mixed anew with the juice, and the whole is allowed to ferment. When active fermentation has ceased, which is known by the subsidence of the mass in the vat, by the cessation of the escape of carbonic acid, by the temperature of the liquid falling, etc., it is found that the latter has lost its sweetness in great part, has become clear, and has acquired the vinous taste. It is then drawn off into casks, where it long continues to ferment, as the escape of froth from the bung-hole proves. As the liquid diminishes under this process, it is renewed by additional quantities. When all fermentation has ceased, the wine is kept perfectly at rest, in order to its becoming clarified. During this period a deposit is formed (lees), which consists of bitartrate of potassa, coloring and vegetable matter, etc. After the lapse of five or six months, it is racked off into other casks, and this process is repeated every year, at the same period, until the wine is fit for use. In order to purify the wine, and free it from everything capable of injuring its qualities, it is subjected to *sulphuring*. This operation consists in burning one or more sulphur matches in the empty casks just previous to filling them with wine. It is believed to prevent its turning sour. The liquor is further purified, or *fined*, by the addition of isinglass, or white of egg, or the blood of an animal newly killed. The first forms with the tannic acid, and the others with the alcohol, reticulated coagula, which envelop and

[1] Lehrbuch, etc., ii. 316.

carry down the solid particles which endanger the safety of the wine. When completely clarified, the wine is preserved in casks, or still better, in bottles. Some wines, as the Rhenish, may be preserved for an indefinite period; others but for a short time only. Pliny speaks of wines more than two hundred years old.[1]

Constituents of Wine.—These are many and various, as, indeed, the sensible qualities of the liquor make manifest; but the following are discoverable by chemical analysis: Water; alcohol; extractive mucilaginous matter (*Chevallier*); carbonic, acetic, tannic, tartaric, and malic acids (free); bitartrate of potassa; tartrates of lime, alumina, and iron; chlorides of sodium, potassium, calcium, and magnesium; sulphates of potassa and lime; blue or yellow coloring matter; grape sugar; and œnanthic ether, with œnanthic acid, from which the characteristic odor, or bouquet, of each wine is derived.

Of the above elements the most important is alcohol, as upon its presence nearly all of the qualities depend which invite the use of wine. Its proportion varies, in the better sorts, between 7 and 26 per cent. The following tables may be considered as representing this proportion with some accuracy; but it is to be remembered that, apart from adulteration, natural causes produce great variation in this respect. The proportion, for instance, depends chiefly upon the quantity of sugar contained in the grapes from which the wine is made. Again the age of wine, within certain limits, controls its alcoholic element, because every year adds something to the generation of alcohol from the decomposition of the saccharine element. On the other hand, it should not be forgotten that wine, in casks at least, must constantly part with a portion of its alcohol by evaporation. Christison is of opinion that it continually grows stronger until the conversion of its sugar is complete, after which its strength declines. Numerous analyses have been published showing the proportion of alcohol in different wines. The following are the most important:—

STRONG WINES.

	BRANDE.	CHRISTISON.
Marsala	25.09	
Port	22.96	16.20
Madeira	22.27	16.90
Cape Madeira	20.51	
Sherry	19.17	15.37
Teneriffe	19.79	13.84
Constantine (white)	19.75	
Lisbon	18.94	16.14
Malaga	18.94	

RHENISH WINES.

	GEIGER.		GEIGER.
Rüdesheimer	12.65	Steinberger	10.87
Geisenheimer	12.60	Leibfrauenmilch	10.62
Marcobrunner	11.60	Johannisberger (Prout)	8.01

[1] Dieu, Mat. Med., iv. 234.

FRENCH WINES.

	CHEVALLIER.		CHEVALLIER.
St. George's	15.00	St. Estephe (red)	9.70
Barsac (white)	14.75	Château Latour	9.33
Champagne (still)	12.77	St. Emilion	9.18
Beaune (white)	12.20	Léoville	9.10
Champagne (sparkling)	11.77	Pouilly (white)	9.00
Hermitage (red)	11.33	Château Margaux	8.75
Volnay	11.00	Château Lafitte	8.70
Bordeaux (red)	10.10	Macon	7.66
		Chablis (white)	7.33

These results are presumed to have been obtained from pure specimens of the several wines, but cannot be assumed to apply to the liquors bearing their names which are found in commerce. This remark is true even of wine-producing countries, and consequently much more so of those to which the liquor is exported. Strumpf tells us that the difficulty of obtaining pure, unadulterated wine for domestic and even for medicinal purposes, is well known even in Germany, "for the wine trade is, with few exceptions, in the hands of avaricious usurers, knavish dealers, and greedy landlords, who have more regard for the gratification of their own avarice than for the health and lives of men. French, Spanish, and all other foreign wines seem, without exception, to be artificial rather than natural productions. Still worse, even German wines seldom form an exception to this statement, and it were easier to obtain pure musk or genuine cinchona bark, than faultless wine. Under such circumstances it is a precarious matter to attempt the cure of our patients with a liquid which is hardly ever what it ought to be."[1] This complaint seems to be the very echo of that which was uttered by Pliny eighteen hundred years ago. Discussing the question which was the best wine, he exclaims, "But if all were agreed which is best, who could get it? Our very princes do not drink pure wine. To such a pitch has villany arrived that one can buy nothing more than the name of a vintage; from the very wine vat all of it is adulterated. And so, marvellous to tell, we may say of wine, the poorer the purer."[2] It does not belong to our province to present details of the falsification of wines, but a simple enumeration of the substances employed for this purpose may not be uninstructive. Wines are diluted with water, and some specimens are fraudulent substitutions of cider or perry for the juice of the grape. Inferior qualities are made saleable by the addition of a small proportion of a better description, and mixtures of various sorts ingeniously counterfeit the finer qualities; alcohol is added to thin wines, sour ones are sweetened with sugar, honey, or raisins, and pale ones are colored with burnt sugar. Acidulous wines have their acid neutralized by the alkalies, or by lime. Acetate of lead is sometimes fraudulently mixed with wines to give them a certain astringency, but more frequently is an accidental ingredient derived from shot used in cleansing the bottles, or by the liquor having

[1] Handbuch, i. 956. [2] Hist. Nat., xxiii. xx.

passed through leaden pipes. In an English manual for wine-dealers occurs the following recipe, which has been justly stigmatized as infernal: "To keep wine from turning sour: put in the casks two pounds three ounces of small shot." As if this were not villanous enough, it proceeds: "In extreme cases, when all the previous receipts have been tried without any satisfactory result, take a pinch of oxalic acid, and put it into the bottle."[1] Red wines are often manufactured out of alcoholic dilutions, colored by logwood, rhatany, beets, litmus, etc. etc. Astringency is given them by means of alum, oak, or willow bark.

Action upon Man.—The action of wine is essentially stimulant. This property it derives chiefly from its alcoholic element, but in a degree which is far from being measured by the proportion of the latter, and it is further so completely modified by the other elements contained in the liquid, as to render the direct and still more the ulterior effects of wine widely different from those of ardent spirits. This peculiarity appears to be derived from the salts, acids, sugar, and ethereal elements in which it abounds, and which, while they moderate the stimulus produced by the alcohol, insure a more rapid discharge than would otherwise occur of the latter substance. Hence it is incorrect to suppose that the alcohol contained in any given specimen of wine represents precisely its intoxicating power, or to assert, as some have unwisely done, that because a wine contains a certain percentage of alcohol, its effects upon the system will be identical with those which a like amount of alcohol diluted with water alone would produce. The stimulant effects of wine are experienced by the whole organism; the activity of the nervous system is quickened, the senses are all rendered more acute, the intellectual faculties acquire an unwonted rapidity and energy, the imagination is filled with a succession of pleasing or brilliant ideas, the affections are aroused to unaccustomed warmth, and, in particular, the amorous propensity is awakened. The pulse beats quicker, the cheek is flushed, and the eye is bright, the whole person seems expanded, the wrinkles of time and care are smoothed, and all images of doubt and apprehension disappear. These effects are most strikingly produced by those of the sparkling wines, which contain a large proportion of carbonic acid and but little saccharine matter. If the last-mentioned constituent is in excess, it tends to derange the digestion. The dry wines, on the contrary, such as Bordeaux and sound Sherry, but particulary the former, tend but little to disorder the stomach, but are less exhilarating than the sparkling sorts.

The effects which have been described can hardly be considered as lying beyond physiological limits, unless by frequent repetition they induce a permanent derangement of the function either of digestion, innervation, or nutrition; but the following, which characterize a certain degree of intoxication, are essentially pathological. Under the influence of larger quantities of wine, or of its more

[1] Brit. For. Med. and Ch. Rev., April, 1858, p. 324.

stimulant varieties, the genial and pleasureable excitement above described degenerates into a state bordering on delirium, which, according to the temperament of the individual, is gay or furious, incoherent, maudlin, or churlish. It is in this stage of intoxication that quarrels and combats take place, and the crimes are committed which must be laid to the account of intoxicating drinks, whether fermented or distilled. These phenomena of violent excitement are succeeded by symptoms which show the subsiding influence of the stimulant; the speech is no longer loud and clear, but thick, slow, and incoherent, the head whirls, and all surrounding objects appear to move in a confused dance, the general sensibility is blunted, the hand seizes objects unsteadily and with an evidently impaired perception of their character, and, indeed, all the senses are more or less confused, the limbs bend under the weight of the body, and at last refuse to support it altogether. The curious remark has been made that those functions which habitual exercise has strengthened are generally the last to give way. The intellectual and educated man retains his reasoning powers long after his limbs refuse him the power of rising from the table; while the ignorant laborer will keep his feet and even carry burdens, when his mind is utterly bewildered and his speech quite lost.

When all the faculties are benumbed, and the muscles refuse to contract, there generally occurs derangement of the stomach, with violent and repeated and often prolonged vomiting, and not unfrequently the bowels and bladder at the same time are emptied of their contents; or, if these effects do not present themselves, the phenomena of narcotism supervene, with injected face, dilated pupils, a slow and full pulse, or else a small and frequent arterial beat, stertorous breathing, and a clammy noisome sweat over the whole body. This condition may pass into real and fatal apoplexy, or, after a protracted sleep, the drunken man may awake, but without any recollection whatever of the scenes of riot and brutality which he has enacted.[1]

[1] The ancients have so well described the effects of wine, as well as of intemperance in its use, that there needs no apology for citing from them a few examples:—

"How exceeding strong is wine! it causeth all men to err that drink it; it maketh the mind of the king and of the fatherless child to be all one; of the bondman and of the freeman, of the poor man and of the rich: it turneth also every thought into jollity and mirth, so that a man remembereth neither sorrow nor debt; and it maketh every heart rich, so that a man remembereth neither king nor governor. . . . . And when they are in their cups they forget their love both to their friends and brethren, and a little after draw swords: But when they are from the wine, they remember not what they have done." I. Esdras iii. 18.

This passage and the following ones are from very different sources, yet they seem to be paraphrases of each other:—

"Vina parant animos, faciuntque caloribus aptos.
Cura fugit, multo diluiturque;
Tunc veniunt risus, tunc pauper cornua sumit;
Tunc dolor et curæ, rugæque frontis abit."

Ovid, De Arte Amandi, lib. i.

The reverse of this picture is drawn by Lucretius, thus:—

"Denique cur, hominem cum vini vis penetravit
Acris, et in venas discessit diditus ardor,

The habitual dietetic use of the lighter wines can hardly be considered injurious, since it is common to all sexes and ages in the vine-growing countries of Europe. But they are always diluted with water in proportion to the youth or the delicacy of the constitution, and are very seldom taken in excess. "As a restorative, a means of refreshment where the powers of life are exhausted, of giving animation and energy where man has to struggle with days of sorrow, as a means of correction and compensation where misproportion occurs in nutrition, and the organism is deranged in its operations, and as a means of protection against transient organic disturbances, wine is surpassed by no product of nature or of art. The nobler wines of the Rhine, and many of those of Bordeaux, are distinguished above all others by producing the minimum of injurious after-effect. The quantity of wine consumed on the Rhine, by persons of all ages, without perceptible injury to their bodily health, is hardly credible. Gout and calculous diseases are nowhere more rare than in the district of the Rhinegau. In no part of Germany do the apothecaries' establishments bring so low a price as in the rich cities on the Rhine, for there wine is the universal medicine of the healthy as well as of the sick. It is considered as milk for the aged."[1] Still, it is generally recognized as true that children and females are better without wine, that it is very apt to develop adult functions and passions prematurely in

Consequitur gravitas membrorum? præpediuntur
Crura vacillant? tardescit lingua? madet mens?
Nant oculi? Clamor, singultus, jurgia, gliscunt?
Et jam cætera de genere hoc quæcumque sequuntur?"

De Rerum Naturæ, iii. 475.

The consequences of confirmed inebriety are vividly described by Seneca. "Inde pallor, et nervorum vino madentium tremor, et miserabilior ex cruditatibus, quam ex fame macies; inde incerti labantium pedes, et semper qualis in ipsa ebrietate, titubatio; inde in totam cutem tumor admissus, distentusque venter, dum male assuescit plus capere, quam poterat; inde suffusio luridæ bilis et decolor vultûs, tabesque in se putrescentium, et retorti digiti articulis obrigicentibus, nervorum sine sensu jacentium torpor, aut palpitatio sine intermissione vibrantium. Quid capitis vertigines dicam? Quid oculorum auriumque tormenta et cerebri æstuantis verminationes."—*Epistol.*. xcii. § 16.

A picture even more loathesome in its moral traits, if less precise in its physical deformity, is painted by Pliny, Lib. xiv. cap. xxviii.

The following verses of Obsopæus may serve as a pendant to the Roman pictures:—

"Hæc ebrietas, cultoribus ista rependit
Dona suis; hosti vix satis apta dari.
Ebrietas furiale malum, blandumque venenum,
Mellitum exitium, dulcis amarities.
Ebrietas vitium deforme; et fæda voluptas."

De Arte Bibendi (1536).

Matthiolus, after extolling wine as the prince of all liquors, and indicating its precious uses in disease, says: "For all that, let no drunkard console himself, for, as all extremes are mischievous, so also is excess in drink." If in moderation, and judiciously given, it acts as a salutary stimulant, but when ingurgitated as it is by winebibbers, it extinguishes life, as too much wood puts out a fire. It is then the cause of "apoplexy, epilepsy, paralysis, trembling, vertigo, spasms, insanity, etc., besides corrupting the whole life, rendering men quarrelsome, babbling, impudent, of unsound judgment, and addicted to gambling and debauchery, out of which come murders and homicides."—*Comment. in Dioscorid.*, v. vii.

[1] Letters on Chemistry, p. 454.

the former, and to impair more or less the delicacy and freshness of the complexion in the latter. It seems not improbable that the superior purity of complexion observed in English and American women as compared with those of continental Europe may be due in part to the abstinence of the former from all vinous and alcoholic drinks, especially in early life.

Uses.—Although the remedial powers of wine depend essentially upon the stimulant qualities which it derives from alcohol, yet its effects differ from those of distilled spirits not only by their lower grade of intensity, but also by the simultaneous operation of its other and especially of its ethereal elements. These modify the operation of the alcohol, and to a certain extent counteract its mischievous tendencies. They render its stimulant operation more diffusive and cordial; more grateful and less injurious to the stomach even when taken in excess; and less apt than distilled spirits to leave unpleasant effects behind it. If wine is employed in the treatment of the same forms of disease as alcohol, it is nevertheless more applicable to their milder grades, for a more continuous use, and for cases in which the susceptibility of the stomach or of the nervous system is offended by alcohol alone. Hence it is more appropriate in the treatment of the diseases of the old and the very young and of females, in all of which cases its peculiar and distinctive qualities as a cordial give it the superiority over distilled liquors. The following illustrations of its uses will be sufficient to illustrate its characteristic advantages, it being premised and understood that genuine wine is alone the subject of discussion, and not the factitious or adulterated liquors which in this country far more than in Europe are used to rob the purses and destroy the health of those who consume them.

Fevers.—In all forms of fever which assume the typhoid or adynamic type, and in which, generally, the constitution of the blood is more or less impaired, wine imparts an artificial strength, and sustains the organism against the destructive processes going on within it until these have exhausted their power. It perhaps also aids the system in throwing off morbid materials contained in the blood. Its virtues are most conspicuous in petechial typhus, the "putrid malignant fever" of Huxham, in which, says this author, "I cannot but recommend a generous red wine as a most noble, natural, sub-astringent cordial, and perhaps art can scarce supply a better."[1] Pringle speaks of giving half a pint of strong wine daily in such cases, or a quart of light French or Rhenish wine, yet this is little, compared with what has sometimes been administered with palpable advantage. In one case reported by Dr. Stokes, the patient in thirty-three days took about fourteen quarts of port wine. In another, two dozen of wine, besides six bottles of brandy, were used.[2] Dr. Chadwick says that in typhoid affections he has frequently exhibited a bottle of port or even a quart of brandy, in the

[1] An Essay on Fevers, p. 123. [2] Times and Gaz., May, 1854, p. 507.

course of twenty-four hours.[1] The symptoms which directly call for its use are prostration, petechiæ, stupor, and brown tongue; feebleness, irregularity, dicrotism, and softness of the pulse; and particularly feebleness or absence of the impulse and first sound of the heart. The last symptom, which, when it exists, demonstrates more clearly than the rest the utter prostration of the vital powers, was first pointed out by Dr. Stokes as an indication for the use of wine in *typhus fever*, and its importance was confirmed by Graves.[2] The latter states, as the signs of its usefulness, that the tongue becomes moister, the pulse and respiration slower, and the skin softer, while the delirium and restlessness subside, calm sleep supervenes, and the impulse and first sound of the heart resume their proper force. Mr. Higginbottom, of Nottingham, England, a gentleman of large experience, asserts, on the other hand, that alcoholic stimulants are hurtful, and not useful, in typhus fever; but, as he couples this assertion, which he justly suspects may be considered "Utopian," with the rejection of alcoholic stimulants from the treatment of all diseases whatever, his judgment may be suspected of an unconscious bias.[3] Dr. Wilks, of Guy's Hospital, has placed the subject on a ground more in harmony with general experience. He has shown that, although alcoholic stimuli cannot be viewed as essential to the cure of typhus, or as specifics for that disease, yet that success in its treatment depends in a great measure upon their proper management.[4] The indications for their use have been pointed out above, and we need only add that to employ them before they are needed is to forfeit their advantages when they become essential to the cure. In *typhoid fever* the need of wine is generally less urgent than in typhus, and, in fact, the use of evacuants is more commonly tolerated. Still, in some cases, from an early period of the attack, and in others at a later stage, low typhoid symptoms declare themselves, of which the most striking are dryness and a brownish coating of the tongue. Large quantities of wine are seldom called for, but wine-whey is frequently found of essential service, as, indeed, Huxham long ago taught in laying down the treatment of "a slow nervous fever."[5] Still later in the disease, when active symptoms have been replaced by exhaustion, languor, and debility, with absence of appetite and imperfect sleep, the cordial operation of wine is a precious help towards the cure.

During *convalescence* from fevers, and in all diseases in which the local lesion has either been cured or is not in danger of being aggravated by stimuli, a moderate use of good wine with food directly promotes its digestion in a high degree, and at the same time tends to inspire that genial sense of comfort which, indirectly, is one of the important conditions of recovery from disease, as it also is of the preservation of health. In many diseases the *debility* which results from copious and prolonged *discharges*—as of blood, pus, or

[1] An Essay on the Use of Alcoholic Liquors, p. 122.
[2] Clin. Med., p. 183.
[3] Lancet, Aug. 1857, p. 166.
[4] Guy's Hosp. Reports, 1855, vol. i.
[5] Op. cit., p. 82.

mucus—from the lungs, bowels, uterus, vagina, or urethra, or from fistulæ, ulcers, or recent wounds, is diminished in a marked degree by wine, especially by the red wines of Bordeaux. In many, also, where, by reason of long repose or protracted *pain*, the strength declines, or the blood is impoverished, as in *scurvy* and *chlorosis*, or is probably impaired, as in atonic or irregular *gout*, the use of a moderate proportion of sound wine restores, more than any other single remedy, the tone and vigor of the system. It has even been remarked that strumous and other allied affections, occurring in the children of persons accustomed to a rich and stimulating diet, cannot be successfully treated without in some degree sustaining the action of the economy by means of a certain portion of wine taken with the food. Dr. Chadwick states, what general experience will doubtless confirm, that many cases of disease of the eye and of the scalp, in such children, can only be cured by wine and rich animal food.

In *syncope*, or rather when this condition is imminent, or the patient is reviving from its effects, the use of wine is general and even popular. Such states are met with after great hemorrhages, or other discharges, as the result, also, of severe pain, the shock of wounds and other injuries, of great alarm, of debility of the heart, etc. The remedy is not less appropriate in cases of great *fatigue* from application or anxiety of mind, and of exhaustion from prolonged distress; and some varieties of it, particularly the red Bordeaux wines, are capital stimulants of the digestion when this function languishes under any of the causes which have been enumerated. Aran[1] has recommended wine by enema as a tonic stimulant in cases of *gastralgia* in which the stomach refuses to bear the preparations of iron.

Wine is sometimes used with great advantage in *delirium tremens*, but is less commonly resorted to than brandy or whiskey. The virtues of alcoholic remedies in this disease will be pointed out hereafter. In some of the minor *spasmodic* affections, and particularly in spasmodic vomiting, such as occurs in pregnancy and sea-sickness, the sparkling wines taken cold are often of immediate and permanent utility. *Infantile convulsions* originating in the irritation produced either by dentition or by undigested food in the alimentary canal, may frequently be prevented by a timely dose of wine, or relieved by its administration by the rectum or the mouth. *Tetanus* has also been successfully treated with wine. Dr. Rush relates[2] that a quack in New England cured tetanus by giving *ardent spirits* in such quantities as to produce intoxication, and Dr. Hosack records four cases of traumatic tetanus cured by wine in his own practice, and refers to another similar one reported by Dr. Wistar.[3] Currie, also, reports a case of the same disease which recovered after forty-two days of treatment, during which time one hundred and ten bottles of port wine were administered.[4] He further describes an

[1] Bull. de Thérap., xlviii. 10 and 54.
[2] Works, i. 168.
[3] Essays, ii. 245.
[4] Med. Reports, i. 148.

attack of tetanus in the horse, which was cured by the same means, "though not till the animal had drunk as much wine as he was worth."[1] The ancients used wine as an antidote to narcotic poisons, and it has likewise in later times been recommended in poisoning by mercury, arsenic, and cantharides. But modern experience has not lent its sanction to such uses of wine. As an alcoholic stimulant, it may, however, be of service in counteracting the depressing effects of hydrocyanic acid and of tobacco.

Red wines are also used as injections into the tunica vaginalis testis after the operation for *hydrocele;* into the urethra and vagina in chronic discharges from these passages, and into fistulous sores to mitigate their secretion. Jobert and L'Homme proposed injections into the peritoneal cavity after the operation of paracentesis in ascites, but their results are not adapted to encourage imitators.

ALCOHOL.—Alcohol.

History.—Long before it was known to the Western world, the art of distilling appears to have been practised in China, where it was applied to the production of alcohol from fermented rice.[2] The earliest notice of alcohol by a modern writer seems to be that of Marcus Græcus, who is supposed to have lived in the latter half of the thirteenth century. This writer describes the distillation of alcohol (*aqua ardens*) from strong wines. About the same period Cardinal Vitalis de Furno eulogized this liquor as a panacea; Raymond Lulli (1315) styled it the supreme cordial of the human body, and Arnold of Villa Nova bestowed much pains upon perfecting it in the shape of spirituous drinks. In the latter half of the fourteenth century, its use was general as a cordial throughout Germany and Italy, although its mode of preparation was kept secret by the chemists. It bore various names, of which one of the most common was *vinum adustum*, in German *gebrannter Wein*, or *Brannt-Wein*, whence are derived the French *brandevin*, and the English *brandy*. In most languages, also, it bore a title corresponding to the English "spirits of wine." The name of *alcohol*, which it received in the sixteenth century, is not, it would seem, of Arabian or Chaldaic etymology.[3] It was applied as a general term to all bodies in a state of very minute subdivision, and hence to all refined and subtle products, such as the distilled spirit of wine. The art of extracting alcohol from wheat, barley, and other cereals was early discovered, as may be inferred from the fact that in 1595 the danger of perverting these productions from their natural uses was perceived and prohibited under heavy penalties. Very soon afterwards alcoholic preparations made from the juice of the sugar-cane, from molasses, the cocoa-nut, rice, etc., came into vogue, and

[1] Med. Reports, p. 150.
[2] Morewood, an Essay, etc., on the Use of Inebriating Liquors.
[3] According to Hoefer, alcohol signifies "that which burns."

in the eigtheenth century various fruits, and, above all, potatoes were prostituted to the same purpose. In 1796, Lowitz and also Richter discovered the means of rendering alcohol absolutely pure, by depriving it of water by means of carbonate of potassium, and chloride of calcium.[1]

Preparation.—"Alcohol is a product of vinous fermentation, which consists in the decomposition of grape or cane sugar into carbonic acid and alcohol. It is also generated when ether (oxide of ethyl), separated from its combinations, comes into contact with water." It is obtained in a diluted state (*ardent spirits*) by distillation from any liquid in which vinous fermentation has taken place, such as wine, beer, etc. In vine-growing countries, as France, it is extracted from wine, and is called *brandy* (*brandevin*); *whiskey* is yielded by a fermented infusion of wheat, rye, barley, or potatoes, and when rectified with turpentine is called common gin, and with juniper berries Holland gin; *rum* is obtained from the distillation of molasses; *ratafia* from sugar-cane juice; *arrack* from rice and the cocoa-nut; *Kirschwasser* (cherry water) from crushed cherries; *slivovitz* (an alcoholic drink used by the people of Austria, Hungary, Bohemia, and Poland) from plums. These forms of ardent spirits contain different proportions of alcohol varying from 20 to 55 per cent. Brandy, rum, gin, and whiskey contain from 50 to 55 per cent. of pure alcohol, according to Brande. The peculiar taste of the several liquors is due to œnanthic ether, fusel oil, and various ethereal oils; in the case of gin, to the oil of juniper.

The *rectification* of ardent spirits consists in depriving them of their water and volatile oils, and their degree of purity is denoted by their specific gravity. When they have a sp. gr. of 0.920, they are termed proof spirits. This liquid is, however, far from pure, but is further rectified by repeated distillation. The officinal alcohol of the U. S. Pharmacopœia has a sp. gr. of 0.835. *Stronger Alcohol* (Alcohol Fortius) has a sp. gr. of 0.817, and *Diluted Alcohol* (Alcohol Dilutum), which is alcohol mixed with an equal measure of distilled water, has a sp. gr. of 0.941. The specific gravity of absolute alcohol is 0.794.

Properties.—Alcohol is a limpid, colorless, volatile, and inflammable liquid, of an agreeable penetrating odor, and a peculiar burning taste. It has never been frozen. Dr. J. K. Mitchell, who, by the evaporation of solid carbonic acid and ether in vacuo, produced the greatest cold ever attained, found that alcohol of sp. gr. 0.798 became oily and adhesive at —130° F.: by a greater degree of cold it became still thicker; and at —146° F. it flowed like melted wax. Alcohol of 0.820 froze easily.[2] Its boiling point is 172° F. The chemical formula for alcohol is C_4H_5O+HO. It has a strong affinity for water, and when mixed with it evolves heat. This peculiarity explains its action upon certain organic bodies. When immersed in alcohol they part with their water, and shrivel up.

[1] Strumpf, Handbuch, i. 961.
[2] Booth, Encyclopædia of Chemistry, p. 85.

As it also excludes atmospheric oxygen, it hinders putrefaction. Hence its familiar employment to preserve anatomical specimens, fruits, etc. Where, however, it is desirable to retain unimpaired the color and shape of delicate parts, alcohol is objectionable on account of its corrugating the tissues, and coagulating albuminous products. It is a solvent of organic and vegetable alkalies, of urea, sugar, camphor, resins, balsams, volatile oils, castor oil, soap, etc.

Action. *On Plants.*—Alcohol speedily destroys the life of plants when their roots and stems are immersed in it. Its action upon them has been compared to that of hydrocyanic acid.

On Animals.—In large doses it is poisonous to all animals. According to Fontana, leeches wet with alcohol die in two or three minutes. When partially immersed in it, the part of the body which it touches is paralyzed. Forty drops of it given to a frog proved fatal in forty minutes, but when injected under the skin it killed in one minute. It is also fatal, when applied to the brain or spinal marrow, after having induced paralysis. When the crural nerve of a frog is moistened with this liquid, the limb loses its power of motion; the same result, with depressed action of the heart, ensues, when the whole limb is wet with alcohol. Turtles speedily perish under the influence of alcohol, whether it be introduced into the stomach, or the bowels, or into the cellular tissue. The pulsations of the heart soon cease under its application, whether before or after its removal from the animal's body. Fish lose their activity in water containing but a small proportion of this liquid, and birds, according to Flourens, are deprived of sensation and voluntary motion by a few drops of brandy on the exposed brain, and have their equilibrium deranged when it is applied to the cerebellum.[1]

Injected into the veins alcohol produces symptoms depending upon the quantity employed at any one moment, and on the purity of the liquor. As early as 1679–93, Courten, Lanzoni, and Baglivi showed that highly rectified spirit might prove instantly fatal when employed in this manner, and that after death the blood was found coagulated in the heart, lungs, and other parts. Viborg injected two drachms of whiskey into the jugular vein of a horse, and produced all the phenomena of alcoholic stimulation. The animal became gay and warm, the eyes were prominent and bright, the ears moved to and fro, and the pulse was full and active. These phenomena continued for three-quarters of an hour, but gradually diminished, and were followed by signs of depression and debility; but within four hours the condition of the animal appeared to be the same as before the experiment.[2] Segalas injected half an ounce of strong alcohol into the crural or jugular vein of a dog, and, like the earlier experimenters, produced instant death, with coagulation of the blood. When the same quantity, with four or five times its weight of water, was injected at once, complete intoxication followed, with loss of motion, insensibility, abdominal respiration, and a scarcely perceptible pulse; but when it was introduced

[1] Wibmer, Wirkung, etc., i. 90. [2] Ibid.

gradually, in the course of an hour, the symptoms were slight and transient.[1]

Injected into the cellular tissue of a dog, to the amount of eight or ten drachms, Orfila[2] found that the animal became agitated, walking about at random for thirty or forty minutes, but without appearing giddy; he then staggered and vomited bilious matter. Twenty minutes later, in spite of being very giddy, he ran wildly about, frequently falling. At last he lay motionless and insensible on his side, with limbs relaxed, and breathing deeply. In two or three hours more he died. On dissection of his body the only lesion discoverable was coagulation of the blood in the limb operated upon, and in the heart.

In the stomach of large rabbits an ounce of absolute alcohol produced the following results, according to the experiments of Mitscherlich.[3] No excitement ensued, but great depression, and within from two to twelve minutes there was a complete loss of sensibility and muscular power, so that the strongest mechanical excitants scarcely induced the slightest movement; the breathing was hurried and the pulse very rapid; slight convulsions ensued of the feet and eyes, and the pupils, at first contracted, became largely dilated, and death without convulsions took place in from one and a half to two hours. The body was immediately opened. The alcohol appeared to have exerted a chemical action upon the follicular and vascular structures of the stomach. The mucus of its inner surface was coagulated, and in some places stained with blood. Where this had taken place the mucous coat was softened, but elsewhere was fragile and formed of corrugated cells, a result, perhaps, of the withdrawal of water from them by the action of the alcohol. The vascular and cellular coats were thickened by an exudation, which in some cases was clear, and in others bloody. The odor of alcohol was quite perceptible in the peritoneal cavity, but not in the small intestine; the latter organ was but slightly affected, its epithelium being partly replaced by mucus. Mitscherlich is of opinion that this alteration was due not to the direct chemical action of the alcohol, so much as to its constitutional irritation, and he compares it to the condition found where a lingering death has ensued upon excitement in other forms of poisoning. He found no peculiar alteration in any other organ. The brain was moderately congested; the blood was unchanged, and did not emit an alcoholic odor. Jacobi and Falck performed a series of experiments with various mixtures of alcohol and water upon pigeons, rabbits, and dogs, and obtained results similar to those which have been above described.[4] Bouchardat and Sandras have shown that alcohol is absorbed from the stomach by the veins. They found a large proportion in the portal vein of animals sacrificed two hours after using food with alcohol.[5]

[1] Lancet, 1839–40, ii. 443. [2] Toxicologie, 5ème éd., ii. 683.
[3] Lehrbuch, ii. 329.
[4] Brit. and For. Med.-Chir. Rev., April, 1858, p. 530.
[5] Annuaire de Thérap., 1862, p. 212.

The statement is made by Pommer that man is the only animal in whom drunkenness is preceded by great bodily and mental activity, or by a period of intoxication; but, as Graves remarks, this is evidently a mistake, for it is well known that horses, when greatly fatigued by violent exertion, are suddenly revived by porter or even spirits. On one occasion, a quantity of spirits having been mixed with the food of several pigs, they exhibited the first or exhilarating stage quite as evidently as the most rational biped.[1] Bouchardat also states that the notion that no animals are fond of alcohol or display its stimulant effects is erroneous. An old cock greedily devoured bread soaked in brandy, so greedily, indeed, that he soon began to exhibit the ordinary phenomena of intoxication, with sparkling eyes and afterwards a tottering gait.[2] It is worthy of remark that in the latter experiments, when the dose of alcohol was large, the comb and wattles of the birds lost their bright crimson or scarlet hue, and became purple and dusky.

The effects produced on dogs by *the long-continued use* of alcoholic liquors have been described by Huss, after experiments by Dahlström. Three dogs of different ages and dispositions were chosen, and during eight months there was administered to each of them a daily dose of six ounces of common (potato) brandy. The symptoms produced were alike in all, and may be thus summarily described. At first the animals did not exhibit any peculiar aversion to the liquor, but by the end of the first month they would not swallow it unless it was administered by force. During the first three months they displayed a peculiar liveliness which approached delirium (*Wildheit*), and a voracious appetite, after the alcohol had been given. They were also very thirsty. During the whole of this period they continued to be fat and in good condition. In the fourth month their bark began to grow hoarse and lose its clear tone; a harsh and dry hiccup and cough accompanied, the eyes were watery and staring, the sense of hearing less acute, the whole manner listless; the sleep was disturbed by spasms of the limbs, and the animals often uttered plaintive cries; they seemed averse to making exertion, and preferred lying upon the side. After the fourth month they were tremulous while standing, and staggered when they were forced to stand. The limbs, especially the hinder ones, were evidently weak, so that the animals ate sitting. As they lay upon their side, twitching of the muscles of the trunk, as well as of the limbs, was visible, and although their manner was generally indifferent, the sight of other dogs excited them to violent anger and furious attacks, in spite of their weakness. Gradually their strength declined more and more, and the cutaneous sensibility, particularly of the ears, diminished in a remarkable degree. The appetite was also impaired, and at last they showed a decided aversion to food, and could not be induced to devour raw meat. All this time their animosity for other dogs continued, and displayed itself even when they were no longer able to make an

[1] Studies in Physiology, etc., p. 314. [2] Annuaire de Thérap., 1862, p. 212.

attack. None of the dogs lost flesh; on the contrary, they were fatter than at the beginning of the experiment. One of the three died at the expiration of eight months, with signs of complete exhaustion; the others were killed. Similar changes were found in the bodies of all the animals. The stomach was contracted, and its mucous membrane lead-colored and œdematous; the intestinal mucous membrane was unaltered, but covered with thick and fetid mucus. The liver was considerably enlarged, of diminished consistence, and a dark color; the bile was also dark, thick, and stringy; the heart, spleen, and kidneys unchanged; the mucous membrane of the nose, trachea, and bronchia was slightly inflamed; the cerebral vessels were distended with blood; the muscles pale, flaccid, and atrophied, and the subcutaneous fat spongy.[1] The resemblance between the symptoms of these poisoned dogs and those of human drunkards is singularly close.

The experiments of Duchek had essentially similar results, but showed the different influence on nutrition of the stronger and the weaker alcoholic preparations. To a dog two years old, rather thin, and of a small species, was daily given about half an ounce (15 grm.) of absolute alcohol, which was followed regularly by intoxication. Emaciation, and weakness in the hinder limbs, occurred. Death at length ensued, and the blood abounded in carbonates, and contained much sugar. To a large setter two or three spoonfuls of corn brandy were given daily for ninety-three days. Upon this he became very fat, and was quite well, when he was accidentally killed. The blood contained much sugar, but there was no other anatomical change.[2]

On Man. Externally.—When alcohol is applied to the skin in small quantities, and is allowed to evaporate, or if its evaporation is promoted by a current of air, it produces a sensation of cold. When it is rubbed upon the skin it excites warmth, and upon tender places a smarting or burning pain, while it stimulates the functions of the skin itself, and of the organs immediately beneath it; but if its application is continued, it excites permanent redness, and even inflammation. If the skin be abraded and bleeding, it also produces severe smarting and a burning pain, which is, however, transient; at the same time it coagulates the blood and arrests its flow. Similar sensations are produced by its application to mucous membranes, and a copious secretion of mucus and of the fluids from the adjacent glands may take place.

Internally.—Alcoholic liquids, when taken pure and in small quantities, occasion a burning sensation in the throat, a feeling of warmth and constriction at the epigastrium, and the secretion of saliva, and of thickened and then watery mucus, in the mouth and throat. The sense of warmth diffuses itself from the stomach over the whole abdomen, or even the entire body, and is accompanied with an increased frequency of the pulse, and a disposition to per-

[1] Cronische Alkoholskrankheit, 1852, p. 517.
[2] Prager Vierteljahrschrift; and Philad. Med. Examiner, Feb, 1854.

spire. In some, particularly females and nervous persons, these phenomena are attended with a little exhilaration; but in males, and those at all accustomed to alcoholic drinks, the mind is quite unaffected. If alcohol is taken moderately along with food, the food is more readily and rapidly digested, and therefore subserves the purposes of nutrition more completely. The universal habit of employing fermented and distilled liquors in this manner, and the more restricted custom of drinking a glass of spirits before the principal meal, testify beyond all cavil to the instinctive and natural desire for such condiments, and refute all arguments that may be drawn from false science against their utility. That the habit is liable to abuse, and is apt to degenerate into a vice, is true indeed; but such an argument is valid neither against the habit itself, nor against the physiological reason for its existence.

Larger, but still not excessive, quantities of alcoholic drinks have for their direct effect to quicken all the functions, to excite the pulse and animal heat, promote the flow of thoughts, and augment the muscular strength. The face becomes flushed, the eyes are brighter, and a feeling of increased power, both mental and physical, is experienced, accompanied with a disregard of obstacles in the way of accomplishing proposed objects, or a singular misconception of their magnitude. The modest man grows bold, the timid despises danger, the taciturn becomes garrulous, the imaginative enjoys a livelier flow of thought, and, in general, all of the faculties, both mental and moral, assume a more genial action. Sometimes, on the other hand, alcoholic drinks appear to sour or embitter the temper, and the unhappy victim of this peculiarity sits moodily aside, or scowls at the hilarity of his companions. In other cases, again, they excite the most extravagant expressions of grief for trivial causes. But inordinate gaiety and exaggeration of ideas are more common effects.

The effects of intoxication by increasing doses of alcoholic stimulants have been thus graphically described:—

"With his progressive intoxication, an extreme loquacity hurries the individual along into every form of indiscretion, tears the veil of his character, and betrays him into intemperate attacks upon others, or into imprudent avowals with reference to his own thoughts and actions. His imagination revels in unassociated and distorted images; his memory fails; his ideas elude him; and, while still speaking, he forgets the subject of his discourse, and maunders without judgment and without coherence. His virtues decline into defects; his courage becomes bravado, his liberality profusion, his friendship fawning. Meanwhile his physical agitation is in proportion to the disorder of his intellect. The face is flushed, the eyes flash, the brain throbs, and the action of the heart is inordinately excited. Extravagant gestures, reckless and inconsiderate actions, shouts, snatches of songs, and other tokens of frantic gaiety, are alternated with complaints, expressions of resentment, and brawling anger, alike without definite aim or reason. He misapprehends what he hears and sees, and yields instantly to his

own misapprehension. His own voice, as well as that of others, sounds strangely in his ears: if he sings, the notes are false; if he speaks, it is with shrillness and clamor. As the intoxication advances, he is still restless in his movements, but they are wavering and without energy; and, as he totters from side to side, he sees objects double or everything reels around him; or the level of the ground appears to rock beneath his feet, or rise before him to meet his steps. As a close, the speech falters; the indistinct words, the drivelling expression of ideas equally indistinct, linger half muttered on the lips; the features droop, and assume an expression of stolidity; the limbs cross each other, and at last sink powerless; and a benumbing torpor creeps over the senses, as, one by one, the noblest attributes of man's nature fall before the strength of the poison, and the power to consider and to judge lies as miserably extinguished as that to will and to act."[1]

If the alcoholic drink is of the stronger sort, and has been imbibed in undiminished doses while the power of swallowing lasts, more serious symptoms still present themselves. The external signs of consciousness are but little, if at all, perceptible; the face is generally turgid and livid, or deadly pale and sunken; the pupils are contracted or widely dilated, the eyelids droop, and the eyeball is muddy and injected. Vomiting of food or of viscid mucus sometimes follows, or an involuntary discharge of urine (which is apt to contain sugar) and of fæces, with an apoplectic sleep and spasms of the muscles, and a small and frequent or a slow and laboring pulse, with general insensibility even to the most painful irritants, coldness of the extremities, hurried, irregular, or stertorous breathing, and foam upon the lips. This state, after several hours' duration, may end in asphyxia or apoplexy, or may continue from one to three or four days before it terminates in death or in gradual recovery. If the subject of these frightful symptoms survives, he is affected with severe pain in the head, confusion of mind, or *mania à potû;* his strength is utterly prostrated, and he suffers from intolerable thirst. He has no appetite for food, and is unable to retain what he eats; his tongue is heavily coated, his breath heavy and fetid, his digestion almost suspended, and for many days he mopes listlessly, depressed in spirits, and unfit for labor.

All of the phenomena of intoxication which have now been described in detail, appear to be the consequences of a paralyzing operation of alcohol upon the nervous system. Like opium, alcohol is a stimulant in small doses, and in large ones a narcotic; but while the former acts solely through the nervous system, the latter, in addition, corrupts the blood, and substitutes in its composition a mortal antagonist of life, carbonic acid, for the vital stimulant, oxygen, which is essential to every manifestation of life. Besides paralyzing the engine and its conduits, which should convey a vivifying blood to every organ and tissue, it fills them with a liquid which no longer is adapted to stimulate the nervous centres

[1] WILSON, The Pathology of Drunkenness, p. 26.

of animal and organic life, so that the victim of alcoholic intoxication has not only his consciousness blunted, but even his common sensibility is plunged in an anæsthetic state, which, if usually less profound, is also more prolonged, than that induced by chloroform or ether.

When a large quantity of strong alcoholic drink is taken into the stomach at a draught, the symptoms at once produced are those of the highest grade of intoxication that has just been described. Under proper treatment by means of emetics, the stomach-pump, or galvanism, recovery may be looked for even in apparently desperate cases. Such an one was that of a boy, aged 14 years, who drank nearly twenty-seven fluidounces of brandy, and who did not vomit, but was insensible and cold. The stomach-pump removed a liquid having a powerful odor of brandy. The patient remained unconscious for twelve hours, but finally recovered.[1] Death from this rapid saturation of the system with alcohol is by no means rare. Orfila mentions an instance in which a man died immediately from the effects of a large dose of brandy. Dr. Rösch relates three cases in which adults died from the immediate effects of excessive drinking in a few hours. Taylor states that a man died in half an hour after swallowing a bottle of gin for a wager. Rösch also relates the cases of two children in which quite a small quantity proved fatal,[2] and Dr. Seaverns one in which a child two years of age died in about twenty-four hours from drinking less than an ounce of New England rum.[3] A child three years of age drank a gill of raw rum and about two fluidounces of gin. It died in a little more than two hours.[4] Another, about the same age, lived about an hour and a half after drinking about half a pint of whiskey.[5] Lidell relates the case of a boy, aged six years and a half, who died in about twelve hours after drinking "several glasses of brandy;"[6] and De Marmon two cases in boys of five and eight years of age, who drank an unknown quantity of whiskey, and of whom one died in nineteen, and the other in twenty-six hours.[7] The symptoms observed are insensibility, convulsions, stertorous breathing, sunken features, motionless pupils, a thready pulse, a moist cold skin, and death in a state of coma. In the case reported by Dr. Taylor[8] of a child that had swallowed an unknown quantity of brandy, death occurred in twelve hours without a return of consciousness. The mucous membrane of the stomach presented patches of intense redness, and in some places was thickened and softened; portions of it were hanging loosely, and there were patches of black extravasation about it, evidently from altered blood.

The *post-mortem* appearances in acute poisoning by alcohol are

[1] Guy's Hosp. Rep., 3d ser., xiv. 268.
[2] Wharton and Stillé's Med. Jurisprudence, § 734.
[3] Bost. Med. and Surg. Journ., March, 1857, p. 99.
[4] Times and Gaz., Sept. 1860, p. 236.
[5] Am. Journ. of Med. Sci., July, 1863, p. 128.
[6] New York Med. Journ., vi. 402.
[7] Ibid., xii. 521.
[8] Guy's Hosp. Rep., 3d ser., x. 121.

generally the following: The face is swollen or livid, the eyes prominent, the lips blue; the lungs are filled with dark blood, as are also the heart, the liver, and their large venous trunks. The odor of alcohol is perceived in the stomach and chest; the vessels of the brain are congested; there is not unfrequently an effusion of bloody serum under the membranes; and alcohol is alleged by Ogston, Percy, and others to have been found in the ventricles or in the substance of the brain.[1] The stomach is reddened in patches, and there is acute œdema of the lungs.[2]

Effects of Habitual Intoxication.—These have long attracted the attention of physicians. More than sixty years ago they were so minutely and graphically described by Lettsom,[3] that little more has remained for later writers than to retouch and enlarge the picture. This has been skilfully done by Dr. Wilson in the work which has already been referred to. The health of the habitual drunkard may at first appear to be unaltered or but slightly impaired; he may even for some time present the aspect of more than ordinary robustness in his full rounded form and florid complexion. But his complexion exhibits occasionally a peculiar pallor, interlaced with small red streaks, or else a faint tinge of purple. The figure, although round, has a bloated look instead of seeming firm and elastic; the cheeks are flabby, the eyes bloodshot, and the tip of the nose displays a crimson hue. Slight exertions occasion hurried breathing and speedily induce fatigue. The digestion now begins to fail; the meals are taken with less regularity and with diminished zest, or the palate craves the excitement of salted, highly-spiced, or acidulated food. A feeling of nervous exhaustion is experienced on rising in the morning, together with mental depression and trembling of the hands, and these symptoms become almost intolerable until the stimulant which is to allay them can be procured; and they are, besides, renewed as often as the impression of the remedy subsides, to be relieved again and again by a repetition of the same dangerous cordial. In many cases the quantity imbibed is every day increased, until the stomach revolts against the imposition, and by rejecting the liquid forces to a suspension of its use. But the nervous system, no longer sustained by its habitual stimulus, falls into disorder, the muscles all are seized with trembling, the senses convey false impressions to the mind, and the reason itself is reduced to a state of imbecility. Phantasms surround the patient; insects float through the air, or creep upon the walls of his chamber, or upon his person, or, if he is left alone, particularly in the dark, he is haunted by visions more horrible than the sound imagination could conceive. He seems to be in a waking

[1] An Experimental Inquiry concerning the presence of Alcohol in the Ventricles of the Brain. By JOHN PERCY, M.D., Lond., 1829.

[2] Dr. A. MITSCHERLICH relates with full and precise details the case of a man who, after drinking a quart of rum, fell senseless on the floor, and lay in that condition for thirty hours, with his left arm under his body. He survived for five days, during which portions of the skin of the left limb sloughed, and he finally died of congestion of the lungs and brain. VIRCHOW's Archiv, xxxviii. 319.

[3] Memoirs of Med. Soc. Lond., i. 151, etc.

nightmare, in which ghastly and terrible figures of men and animals assault or career around him, or seem upon the point of seizing and destroying him. He may be seen crouching in a corner and covering his eyes in a vain attempt to shut out the phantoms, or rushing wildly around, bathed in sweat, as he endeavors to elude his tormentors; or he lies in bed shuddering, and almost paralyzed with terror, his eyes starting from their sockets, and his dishevelled hair on end. In a slighter degree the patient may be quite free from excitement of manner or language, and yet be a prey to the most grotesque hallucinations or the most absurd delusions about which he will reason with the air of one who has a difficult problem to solve, and not at all in the manner of an insane or delirious patient. This condition is due rather to the prolonged repetition of small doses of alcohol than to any single or even habitual excess.[1]

If these attacks are frequently repeated, and the habit that induces them is not suspended, the whole constitution gradually becomes impaired. Sound sleep is completely at an end, and the hours of rest are filled rather with terror than repose. Even by day the sensibility is so perverted as to occasion a variety of distressing illusions. The energy, both of mind and body, gradually declines, the latter in consequence of the wasting of the muscles, which is seen in the shrunken body, the attenuated limbs, and the general air of decrepitude which not unfrequently accompanies the still bloated and coarsely featured face. Fothergill describes a peculiar condition occurring in an advanced stage of habitual drunkenness: The lower extremities, he says, grow more and more emaciated, the legs become as smooth as polished ivory, and the soles of the feet glassy and even shining, and at the same time so tender that the weight of the finger excites shrieks and moaning, and yet I have known that, in a moment's time, heavy pressure has given no uneasiness. The legs and arms become paralyzed, and thus for years the patients may exist without material change.[2] The same disease was more recently described by Dr. James Jackson, of Boston, evidently without a knowledge of his having been anticipated. Dr. Jackson denominates it *anthrodynia-à-potû*, and the essential correspondence of his own with the earlier description proves the exactness of both.[3]

Not the least remarkable feature of the drunkard's history is the benumbing effect which his vice exerts upon his moral sense. All delicacy, courtesy, and self-respect are gone; the sense of justice and of right is faint or quite extinct; there is no vice into which he does not easily slide, and no crime from which he can be expected to refrain. Between this condition and insanity there is but a single step. Sometimes that step leads at once to drivelling imbecility; in other cases illusions, such as those which characterize delirium tremens, become fixed and permanent; or mania results

[1] Compare Lasegue, Arch. Gén., March, 1869, p. 513.
[2] Mem. Med. Soc. Lond., i. 159.
[3] New England Journ. of Med. (Oct. 1822), xi. 351.

from the hideous character of these illusions, and sometimes displays itself in a homicidal or an incendiary form.[1]

With these, or analogous evidences of the constitution's decay, the digestive function is seriously impaired; a constant waterbrash is present, or is most distressing in the morning; the food is rejected soon after being swallowed, or gives rise to heartburn and oppression; the tongue is fissured, rough, flabby, and tremulous; "the breath smells like rotten apples" (*Lettsom*); the bowels are irregular, and often the seat of colic, and hæmorrhoids are of frequent occurrence; the liver becomes cirrhosed,[2] ascites follows as a consequence of this lesion, and thus the tumid belly and the shrunken limbs form a contrast which is one of the most striking phenomena of this disease. At the same time the skin grows dingy, the eye jaundiced, watery, and bloodshot; sharp neuralgic or rheumatic pains rack the limbs, and sometimes a morbidly acute sensibility affects the latter, and the feet especially. In some cases the extremities lose all power of action, and even their sensibility, the palsy extending from the periphery to the centre, and occasionally a like paralysis affects the bladder, the rectum, or the œsophagus.[3] "Thus universally assaulted, without rest and without support, and, alas! without sympathy, nature yields up the conflict. The senses and the intellect glide into utter imbecility, which expresses itself in vacant mumblings; and death, in a worldly sense a deliverance, terminates the miserable scene, the craving for spirits having not rarely subsisted to the close. One by one the lights have been removed from the banquet of folly, and the last is now extinguished." (*Wilson.*)

It would not be consistent with the objects of this work to present a more detailed account of the manifold evils inflicted upon the health by an abuse of spirituous liquors. It is believed, however, that none of importance has been passed without notice. But in order to complete the picture it is necessary to describe, with such brevity as the case permits, those structural alterations which the habit of alcoholic intoxication induces.

Lesions produced by Chronic Alcoholic Poisoning.—Kubick states that the *blood* of drunkards, when drawn from a vein, furnishes a small and soft clot, with a yellowish-green surface, the serum is

[1] Mr. Winslow stated, some years ago, that out of 495 insane persons in the Liverpool Asylum, 257 owed their insanity to drunkenness. In the Richmond Hospital, Dublin, out of 286 cases, 185 arose from drunkenness. (*Lancet*, 1839–40, i. 545.) In the Glasgow Lunatic Asylum, the proportion during six years may be stated at one-fifth from this cause. In England, nine provincial private asylums furnish a porportion of insane cases from this cause of 36.62. (*Carpenter*, Prize Essay, Am. ed., p. 47.) Dr. Howe alleges that, of 300 idiots in the State of Massachusetts, whose history he investigated, the immense proportion of 145 were the offspring of intemperate parents.

[2] The remarkable influence exerted by reducing the allowance of alcoholic drinks in diminishing the occurrence of liver-complaints in India, is shown by the history of the Cameronian regiment in Bengal. The mean of three years, in which a large quantity of spirits was used, was 128 cases, while in two years of temperance, the mean number of cases was 66, or about one-half. (*Lancet*, 1840–41, ii. 557.)

[3] Huss, op. cit., p. 383.

turbid, yellowish-green, and opaline; and the clots in the large veins are dark, soft and incomplete. Shultz supposes that the usually dark color of the blood favors the supposition of its having undergone some special change, which, however, he does not admit to be an excess in the proportion of its hydrogen and carbon.[1] He also performed upon animals some experiments intended to elucidate this question, but, as they consisted of injecting alcohol into the veins, they cannot be regarded as illustrative of the action of alcohol taken into the stomach, and as an habitual drink. According to Huss, the blood has frequently a milky aspect, which he ascribes, in common with several other writers, to an excess of fatty matter.

The *stomach* is generally much smaller than natural,[2] and is often affected with thickening of its muscular coat; its mucous membrane is seldom sound, but of a slate color or still darker, studded with enlarged mucous follicles (mammillated), and covered with a thick coating of tough mucus. The mucous coat is likewise thickened, and not unfrequently the seat of ulcers. The *small intestine* sometimes, but not frequently, presents similar alterations.

The *liver* is the seat of very characteristic alterations; that is to say, it most frequently presents the several stages of the so-called "fatty liver." This is generally accompanied by a great increase in its size. Cases have been reported in which it weighed eighteen, twenty, thirty, and even forty pounds. In some instances the organ is contracted, hardened, and nodulated, in a word "cirrhosed," or presents the appearance of yellow wax. This change appears to be the consequence of the adhesive inflammation, or at least the obliteration, of the portal veins, and is usually attended with abdominal dropsy. Wine and beer are most apt to render the liver fatty, but raw spirits, especially if taken on the empty stomach, more frequently occasion cirrhosis.

The *kidneys* are frequently, but by no means uniformly, the seat of granular degeneration or of atrophic changes (Bright's disease). In such cases, too, it seems probable that this disease is not so much a direct result of the action of alcohol as of other causes, such as cold, which act upon the kidneys all the more easily in consequence of the state of erethism in which they are kept by stimulating drinks.

Adipose matter is generally very abundant in the bodies of drunkards, both in the subcutaneous cellular tissue, and around the heart and kidneys, and in the omentum. In the last situation it has been described as "ashy-gray and slushy."[3]

In other organs than those mentioned, and particularly in the *heart* and *brain*, lesions are occasionally found which writers have attributed to slow poisoning by alcohol; such, in the former, are valvular diseases, hypertrophy, and atrophy; and in the latter,

[1] Monthly Journ. of Med. Sci., Oct. 1841.
[2] Ogston, Br. and For. Med.-Chir. Rev., July, 1855, p. 192.
[3] N. Y. Journ. of Med., iii. 336.

dilatation of the bloodvessels. But these alterations of structure occur with too little regularity in drunkards to warrant our regarding them as effects of their vicious habits.

Modus Operandi.—Alcohol is absorbed with great rapidity by the veins of the stomach and intestines, and may be traced in the blood, the bile, and the urine. Dr. Percy extracted from the urine of an habitual drunkard a liquid which had all the aspect of alcohol, and burned with a blue flame.[1] But Bouchardat and Sandras assert positively that alcohol is eliminated by none of the excretory organs, and that a small portion only is exhaled from the lungs.[2] According to the authors just named, it is speedily converted by the inspired oxygen into water and carbonic acid, or else into acetic acid. Since the employment of chromic acid as a test of the presence of alcohol,[3] it has been made very plain that small or moderate doses of alcohol are not eliminated with the urine in any appreciable quantity. The use of this test has also rendered it certain that of any given dose of alcohol taken into the stomach a very minute proportion only is voided with the urine. And this notwithstanding the fact that, as Anstie observes, "owing probably to its paralyzing influence upon the sympathetic nerves, this substance, in narcotic doses, rarely fails to produce considerable diuresis." Every fact connected with its exhalation through the lungs and skin tends to show that even less of it is eliminated through those organs than by the kidneys. So that it must either be immediately transformed in the system, or retained there for a gradual transformation or elimination, during which time it must exert in a greater or less degree its specific action upon the nervous centres and the blood.[4] Greater precision has been given to these results by the carefully conducted experiments of Subbotin as we find them described by Dupré,[5] and which show that even when enormous doses of alcohol are administered to rabbits, not more than one-fourth of it was eliminated during the succeeding twenty-five hours, and that, consequently, at least three-fourths of it must have been oxidized in the bodies of the animals. These results entirely corroborate those which Dupré obtained by experiments on himself, and which demonstrate that the amount of alcohol eliminated by the breath and urine does not increase with the continuance of an alcohol diet, and is only a minute fraction of the amount of alcohol taken. The residue must therefore be either destroyed, or utilized in the system.[6] Alcohol has been found in the ventricles of the brain. Ogston states that, in one case, nearly four ounces of fluid were found in the ventricles, "having all the physical qualities of

[1] Monthly Journ. of Med. Sci. (1841), i. 739.

[2] Annuaire de Thérapeutique (1847), p. 279.

[3] If one drop of urine containing alcohol be added to fifteen minims of a chromic acid solution (made by dissolving one part of bichromate of potash in three hundred parts, by weight, of strong sulphuric acid), the solution will immediately become of a bright emerald-green color.

[4] Compare SCHULINUS, Arch. de Heilkunde, vii. 97.

[5] Practitioner, ix. 28.

[6] Ibid., viii. 148.

alcohol."[1] That alcohol has been found in the bloodvessels of this organ, as it has been in other parts of the circulatory system, is unquestionable. Graves witnessed the dissection of a sweep, whose brain with its membranes exhaled a notable smell of spirits; and he cites from Cook a case where there was found in the ventricles a clear fluid which had the taste and smell of alcohol, and which took fire on being brought near a burning body.[2] Bouchardat found that the blood of a cock to which alcohol had been administered became strongly impregnated with its odor.[3] A striking example of the apparent presence of this liquid in the blood is mentioned by Dr. Mussey.[4] A medical friend of his bled a man who had been drinking freely for three or four days. The halitus of the blood burned for thirty seconds, with a blue flame, on the application of a lighted taper. Yet it is maintained by Duchek[5] that alcohol, as such, cannot be detected in the blood; and that only aldehyde, a product of its decomposition, is to be discovered in that fluid. Masing, however, showed, that the tests employed by Duchek are fallacious, and that alcohol may pass unchanged into all parts of the system. The experimental researches of Ludger Lallemand, Maurice Perrin, and Duroy, have fully confirmed this statement. Among other results obtained by them was the following. The blood of dogs intoxicated with alcohol on being distilled furnished a liquid which possessed all the characters of concentrated alcohol. It was limpid, colorless, and had the proper smell and taste of alcohol. These authors draw from their experiments a conclusion which they do not warrant. They conclude, since alcohol in substance can be recovered from the blood after having been taken into the stomach, that it cannot be regarded as food, but only as a nervine stimulant, arousing the strength and checking exhaustion under the semblance of a transient invigoration. But it has been well remarked in answer to this conclusion, that in order to afford it a substantial foundation, the experimenters ought to have shown that all or nearly all the alcohol administered could be recovered from the body of the animal which they used. But, as we have seen, the very contrary of this is the fact, and that only a very inconsiderable proportion of the alcohol can be accounted for.

Not only does alcohol by its presence in the blood act through the medium of the nervous system, upon all the functions, but it more directly impedes the blood changes by which oxygen quickens nutrition, saturating the blood corpuscles and the liquor sanguinis, and therefore, in a greater or less degree preventing their oxygenation, or else seizing upon that portion of oxygen which they have acquired in the lungs, and which was destined to promote the waste and renewal of the tissues. To such a conclusion the influence of alcohol in diminishing not only the exhalation of carbonic acid

[1] Edinb. Med. and Surg. Journ. (1833), xl. 293.
[2] Studies, etc., p. 315.
[3] Annuaire de Thérap., 1847, p. 272.
[4] Trans. Amer. Med. Assoc., viii. 575.
[5] Prager Vierteljahrs., 1853, and Philada. Med. Exam., Feb. 1854, p. 90.

from the lungs, but the excretion also of urea and the fixed salts of the urine which has been demonstrated by Böcker and Hammond, distinctly point. It has been inferred from this fact that alcohol diminishes the amount of available energy, but, as has been well remarked by Dupré, the more correct inference would be that alcohol is really capable of taking the place of, and therefore protecting, the tissues of the body from the wear and tear of life. This conclusion explains and justifies its consumption under one form or another, by every nation upon the face of the earth. In this connection another property of alcohol must not be forgotten of which Dr. Beale has suggested the possible influence. The property alcohol possesses of hardening animal tissues, and of coagulating albuminous fluids, is well known. Of course when absorbed by the blood, it does not actually coagulate the albuminous matters; but it renders them less fluid and reduces their permeating property. Alcohol, as just stated, interferes with the disintegration of the blood-corpuscles, and in cases where this is going on very rapidly, and where the blood is passing through the walls of the vessels in considerable quantity, in consequence of the walls themselves being stretched and too readily permeable, alcohol is likely to be of service; and where these changes are occurring very rapidly, and the patient's strength fast ebbing, it may save life.[1]

Finally, in order to indicate as clearly as possible the part which alcohol plays among articles of food, we may cite what has been expressed by Anstie, Voit, and others. They show that the ordinary notion of nutriment is not accurate, for it excludes several substances which are quite as unassimilable as alcohol. Thus Voit defines "a nutriment as a substance which is capable either of furnishing the body any of its necessary constituents or of preventing their removal from the body." Fat, albumen, water, and the mineral elements of the food belong to the first category, and to the second starch, which is not assimilable but hinders the loss of fat, and in certain quantities favors its deposit. If a nutrient is defined to be a substance which by its decomposition furnishes vital force to the body, then water and the mineral elements of food would not be nutrients. Like starch, alcohol limits the decomposition of the organized tissues, and being decomposed in the body, like starch it must give rise to force in the form of heat and perhaps in other forms.

The phenomena attending the so-called "spontaneous combustion" of drunkards prove how thoroughly the body may become saturated with alcohol or its immediate products. It may be remarked of these cases that the subjects of them all were persons addicted to the abuse of spirituous liquors, that they were generally corpulent, and that the combustion of their bodies was nearly total, while the adjacent objects were slightly or not at all injured. The examples of this curious mode of death are too numerous and well authenticated to permit any doubt as to their reality; but they were, in fact,

[1] Protoplasm (1870), p. 63.

examples of "increased combustibleness of the human body," due to its saturation by alcohol.[1]

The addiction to alcoholic drinks, which is universal, could not exist without some good reason; and this fact alone demands that we endeavor to ascertain what is real and what is illusory in the sentiment of the whole human race concerning them. On the one hand, it is certain that alcohol is a poison, and that consequently in employing it we make use of what is, *under certain conditions*, destructive of life. But, in the case of all "poisons," it is their dose and not their nature which renders them mischievous. Examples have been cited of the superior exemption of disease among troops and other bodies of men who abstain from alcoholic stimulants, and which contrasts agreeably with the deplorable results of indulgence in their use by men under similar circumstances. Of the latter, the most striking and painful illustrations have been given, and particularly by British troops in the East and West Indies. After twenty years' service in India, Annesley declared that the habit of dram-drinking destroys more lives in that country than the climate or the sword. Similar testimony might readily be obtained from all who have occupied the same or a similar field of observation. Mr. Marshall long ago proved that in India, at least, ardent spirits neither contribute to enable men to undergo great fatigue, nor to protect them against the fevers endemic to that region.[2] In a very different climate, that of Holland, the experiment was made of giving spirit rations to four regiments, and withholding them from three selected for the purpose. In the former case, the sick in two of the regiments amounted to 1 in 44; in the third to one in 29; and in the fourth to 1 in 46; while in the latter, the proportion of sick in the first regiment was 1 in 116; in the second, 1 in 60; and, in the third, 1 in 158.[3] In this and all similar cases, those who partook of alcoholic drinks did so to excess, and converted a nutriment into a poison. This was notoriously and flagrantly the case among the East Indian troops. It has generally been supposed that such drinks enable men to endure greater fatigue and perform severer tasks, but ample experience to the contrary abounds, whether we seek for illustrations among the icy regions that surround the northern pole, among the snowy peaks of Alpine regions, within the torrid zone, or even in the temperate climates, where the use of such stimulants is most common. Upon this point Dr. I. I. Hayes and other Arctic travellers have furnished emphatic testimony. Dr. Hayes affirms that "alcohol in almost any shape is not only completely useless, but positively injurious," in Arctic countries, and states that even for temporary stimulation under the depressing effects of cold "it should be avoided, for the succeeding reaction is always to be dreaded."[4]

[1] For examples the reader is referred to WHARTON and STILLÉ's Medical Jurisprudence, part ii. chap. viii., and WILSON's Pathology of Drunkenness, p. 92 and seq.

[2] Edinb. Med. and Surg. Journ., xli. 19.

[3] Bull. de Thérap., xxxiv. 450. [4] Amer. Journ. of Med. Sci., July, 1859, 118.

But it is to be observed that this remark applies only to prolonged, continuous, or habitual exertion. That the temporary stimulus of alcohol enables men to exert muscular energies far beyond their habitual power, cannot be questioned, nor, on the other hand, that, more than anything else, it repairs the exhaustion of fatigue, and reanimates the body about to perish from cold. No one, that we know, has successfully controverted these propositions. Is alcohol to be proscribed, because the force which it imparts is only temporary? Upon the same ground we must not only exclude tea and coffee from our dietary, but forego the use of bathing, exercise, and even of fresh air itself, for not one of these, even as much as alcohol, is capable of making any permanent impression upon the economy or modifying its organic composition.

A desire to make the results of experience bend in either direction, and adapt themselves to the suggestions of fancy or to the dogmas of pseudo-science, is nowhere shown more plainly than in the history of the discussions respecting the part played by alcoholic drinks in mending or marring the health of mankind. The most opposite qualities, of good or evil not only, but of the kind of good they confer, or of evil they inflict, are attributed to them according to the measure of knowledge or prejudice, of discernment or blindness of the writer. One, justly distinguished and esteemed for his eloquence and genius, gravely assures us that it is very doubtful if alcohol, even in the most moderate doses and for the shortest periods of time, is ever a stimulant! and quotes Dr. Edward Smith to prove that brandy, taken on an empty stomach, forthwith diminishes the consciousness and the sensibility to light, sound, and touch, and also to prove that among the "early effects" are relaxation of the genital organs and of the sphincter of the bladder. The throbbing pulses which follow alcoholic indulgence are evidences of debility of the heart, and the "exhilaration of the mind is also an anæsthetic phenomenon!"[1] This strange and almost ludicrous perversion of the most familiar and easily appreciated phenomena, is only to be paralleled by the following diametrically opposite dictum of another highly respectable authority: "It may be most fairly suggested, until the contrary be shown, that alcohol acts by stimulation of the nervous system by hastening and assisting the vital functions, the wear and tear of the body, the disintegration of the tissues, and the manufacture of lymph; and that by such disintegration of tissues, the wasting body supplies itself with food during the period of sickness—in fact, lives upon itself."[2] Alcohol, then, according to this estimate of its operation, promotes the very process, which, when occasioned by disease, it is employed to moderate or prevent! Both hypotheses are as inconsistent with each other as they are with the conclusions of simple experience, and the results of the most varied, minute, and accurate experiment.

[1] Br. and For. Med. and Chir. Rev., July, 1861, p. 94.
[2] British Med. Journ., June, 1862, p. 629.

Some estimable promoters of a cause intrinsically good, but sadly injured by its too zealous advocates, have gone so far as to assert that "alcohol is a temporary excitant of the nerves, causing, like friction, or other mechanical irritation, a *sensation* of warmth or glow," while they deny that it furnishes the material for the evolution of caloric.[1] On the contrary, the whole tendency of observation and experiment is to show that the latter is precisely its office. To be more precise: Anstie found, as an average of twenty experiments made upon cats, dogs, rabbits, and guinea-pigs, that the thermometer placed in the ear marked a rise of 3° 56′ Fahr., during the early stages of alcoholic poisoning. But the observations of Lombard are still more conclusive.[2] After swallowing two ounces of rye whiskey diluted with half their volume of water, the temperature of the hand rose from 83° to 96° in about half an hour. At the expiration of a similar interval, the temperature having meanwhile fallen to 94°, an ounce more of whiskey was taken, when the temperature once more rose, and at the end of thirty-three minutes reached 96¾°. In these experiments the temperature of the hand was abnormally low, and when they were repeated with that temperature at 98½°, the increase of temperature was imperceptible, a result at which we need feel no surprise, since even external heat, as shown elsewhere, will not raise the temperature of the body above its normal standard, or about 98½°, because the activity of evaporation is then sufficiently great to exert a cooling influence. The calorifying action of alcohol explains the greater habitual use of this liquor in winter and in cold climates, than in the summer season and in warm climates. As long ago as 1813, Dr. Prout proved that alcohol uniformly lessens, in a greater or less degree, the proportion of carbonic acid contained in the expired air, according to the quantity and circumstances in which it is taken.[3] Böcker has shown that in his own case, during the use of alcohol, the exhalation of carbonic acid from the lungs in twenty-four hours was less than the normal quantity by no less than 165,744 cubic centimetres.[4] And more recently Dr. N. S. Davis, of Chicago, proved that in two hours after a dose of alcohol, the diminution of carbonic acid amounted sometimes to fifty per cent.[5] It offers itself in the place of the tissues to oxygen which would else feed upon them, and thereby retards their waste, while, by the combustion of its elements with this same oxygen, it becomes a source of heat. The careful experiments of Böcker lead to the conclusion that it diminishes the waste of all the tissues whose products are secreted as component parts of the urine, the perspiration, or the fæces.[6] So, too, Liebig declares "that by the use of alcohol a limit must rapidly be put to the change of matter in certain parts of the body. The oxygen of the arterial blood, which, in the absence of alcohol, would have combined with the matter of the

[1] Trans. of Amer. Med. Assoc., viii. 577.
[2] New York Med. Journ., June, 1865, p. 174.
[3] Lancet, 1842–43, ii. 17.
[4] Beiträge zur Heilkunde, i. 254.
[5] Trans. of Amer. Med. Assoc., viii. 577.
[6] Beiträge zur Heilkunde, i. 247.

tissues, now combines with the elements of alcohol. The arterial blood becomes venous without the substance of the muscles having taken any share in the transformation."[1] Whether accurate or not, this theory explains the notorious fact that they who drink alcoholic liquids with their meals consume a proportionately smaller amount of food. "On a very notable occasion—the Peace Congress at Frankfort, the members of which were for the most part teetotallers—an unusual inroad was daily made in certain dishes, especially farinaceous preparations, pastry, etc. The consumption was sufficiently in excess to attract the special notice of the experienced landlord, and his astonishment was not slight or agreeable at finding that his sober guests, at his expense, made up in pudding and sweets what they denied themselves in wine."[2] Finally, that alcohol retards waste is shown by the very diseases which originate in its excessive consumption, by the tendency to an accumulation of adipose tissue, by the fatty degenerations, by the gout, and by other and allied disorders which are occasioned by different forms of alcoholic intemperance. And thus, even by the mischiefs it is capable of entailing is justified that instinctive and world-wide use of it which we have seen to exist. The final cause of that instinct is to be found in the effects of alcohol upon the system which we shall now summarily, but more precisely than in the preceding pages, indicate.

Dr. Hammond, late Surgeon-General of the U. S. Army, has contributed the results of some very carefully conducted experiments to the elucidation of this subject. His conclusions are these: "Under the use of alcohol the carbonic acid and aqueous vapor given off in respiration are lessened in quantity; the amount of fæces is diminished; the quantity of urine is reduced, and its urea, chlorine, phosphoric and sulphuric acids are diminished in amount."[3]

We may add to this division of the present subject by quoting the further results of Böcker's experiments. After showing, as appears above, that alcohol diminishes the waste of the tissues, he goes on to demonstrate its further operation. The following may be taken as a summary of his conclusions: "At the same time that it gives rise in the body to a defensive *reaction*, which is prominent, first, immediately after taking the dose, then gives place to the special action, and on this ceasing is again manifested to a greater extent; so that, if a suitable quantity be taken, and if both action and reaction are allowed to exhaust themselves before the dose be repeated, more manifestation of life, represented by more excretion and more consequent renewal of the body, takes place in a given time with the alcoholic drink than without it. There has been a positive gain in vitality. But, if such a large quantity is taken at once that the reaction is overpowered, or if it is arrested by a con-

[1] Animal Chemistry (Philad. ed.), p. 71.
[2] DENMAN, The Vine and its Fruits.
[3] Am. Journ. of Med. Sci., Oct. 1856, p. 305.

tinuous repetition of the dose, the manifestation of life is kept down; the body is not renewed, because its effete particles are not removed, and the amount of vitality must certainly be reckoned at a loss."[1]

In order further to sustain the doctrine of the usefulness, within due limits, of alcoholic drinks, we shall, at the risk of repetition and of taxing the reader's patience, request his attention to the following assertions of its truth. The late Professor Johnston said, that it is ascertained, of ardent spirits—

"1. That they directly warm the body, and, by the changes they undergo in the blood, supply a portion of that carbonic acid and watery vapor which, as a necessity of life, are constantly being given off by the lungs. They so far, therefore, supply the place of food—of the fat and starch, for example—which we usually eat. Hence a schnapps in Germany, with a slice of lean dried meat, makes a mixture like that of starch and gluten in our bread, and which is capable of feeding the body. So we either add sugar to milk, or take spirits along with it (old man's milk), for the purpose of adjusting the proportions of the ingredients more suitably to the constitution, or the circumstances in which it is to be consumed.

"2. That they diminish the absolute amount of matter usually given off by the lungs and the kidneys. They thus lessen, as tea and coffee do, the natural waste of the fat and tissues, and they necessarily diminish in an equal degree the quantity of ordinary food which is necessary to keep up the weight of the body. In other words, they have the property of making a given weight of food go further in sustaining the strength and bulk of the body. And, in addition to the saving of material thus effected, they ease and lighten the labor of the digestive organs, which, when the stomach is weak, is often a most valuable result."[2]

At the meeting of the British Association in 1862, Dr. Inman presented a paper, the following conclusions of which appear to be true, and in harmony with what we conceive to be the teaching of experience and science: "1. Nature has provided in the salivary glands, the liver, and the lungs of every animal an apparatus for converting all food, especially farinaceous food, into alcohol; and we have no evidence that such conversion does not take place. 2. One form of alcohol or another is available for the support of life, and for restoration to health when no ordinary food can be or is digested. 3. Alcohol, after being taken, is incorporated with the blood, passes into the various tissues, and ultimately disappears, a small portion only passing away in the breath. We can say no more of potatoes, or oatmeal porridge, a small portion of each of which passes out of the body with the fæces. 4. Alcohol, in the form of ale, porter, wine, etc., relieves hunger and quenches thirst simultaneously, and with a completeness that is not equalled by water, infusion of gentian, cayenne pepper, or by turpentine—*i. e.*, it does not act as water simply, nor as a stimulant alone. 5. Wine,

[1] Br. and For. Med.-Chir. Rev., April, 1858, p. 313.
[2] The Chemistry of Common Life (Am. ed.), i. 288.

beer, etc., satisfy the appetite when taken alone, and act for the time as any solid food would do. 6. When alcohol is mingled with other food, a less amount of the latter suffices for the wants of the system than if water had been used as the drink. 7. The various forms in which alcohol is taken have as marked and specific effects as have animal and vegetable articles of diet. 8. Individuals have subsisted wholly upon one or other of the various forms of alcohol in common use for periods of great length; and as it is illogical to conclude that they must have lived on air, without food, or on flies like chameleons, the conclusion is irresistible, and may be left for every thinking man to decide."[1]

Uses.—The special medical uses of alcoholic liquors are so familiar, or so readily inferable from its dietetic employment, that little more than a bare enumeration of them is here required. Dr. Clutterbuck[2] expresses what we believe to be a demonstrable truth, that a moderate indulgence in the pleasures of the table conduces both to the attainment of vigorous health and to the prevention of disease. This we hold to be as undeniable as that excess in the use of alcoholic drinks, like gluttony or voracity, entails the ruin both of body and mind. Yet we do not advocate their general and habitual use, lest, their cordial effects being lost by custom, a temptation should arise to increase their dose beyond the bounds of prudence or safety. Apart even from this danger, there is every reason to think that the habitual employment of any quantity of spirituous liquor is rather mischievous than beneficial; in which respect it differs altogether from wine. It is barely possible, as regards the finer qualities of brandy, that a small portion may be taken daily with the food, for an indefinite period, without injury. There are thousands of the French, both male and female, who for the latter half, at least, of a long lifetime are in the habit of using the *chasse-café*—*i. e.*, a very small glass of pure brandy—after coffee at the conclusion of dinner.

It must never be forgotten that in civilized life there is a comparatively small number of persons in whom the functions are performed with perfect exactness and regularity. Our whole system of preparing food is a standing confession of our feeble digestion; there is not a condiment, a sauce, or a change in the mode of cooking, that is not an evidence of our artificial condition. The refinements of modern society have prolonged the average duration of life, but, by so doing, have increased the number of those who require artificial stimulants, if not for their support, at least for their extrication from dangers frequently brought upon them by constitutional debility. Or, even if the wear and tear of using it have not endangered the integrity of the economy previously to middle life, there generally comes a time when the functions fail,

[1] Lancet, Aug. 1862, p. 188. Compare ANSTIE, Stimulants and Narcotics (Am. ed.), p. 380, where the power of alcohol alone to support life and maintain the condition of the tissues for a long time, is illustrated by several very curious and instructive examples.

[2] Ibid., 1841–42, ii. 97.

and the roundness of the form is succeeded by the rugged outlines of wasted muscles, because the digestive organs are no longer able, as they formerly were, to convert food into flesh. At this period the genial stimulus of alcoholic drinks arouses the stomach, and gives it a vigor which it in turn imparts to every other portion of the body.

But, as a *medicine*, alcohol, in the form of distilled liquors, is frequently required to relieve *temporary debility* of the system. This is strikingly the case after grave accidents, particularly where the tissues are crushed, and also during severe surgical operations; under such circumstances these liquors eminently deserve the name of *cordials*, and prevent that sinking of the courage which may end in fatal syncope. When the subjects of such accidents or operations are of intemperate habits, they are very apt, within from twenty-four to forty-eight hours, or later, to be attacked with delirium tremens, unless a full supply of alcoholic stimulants is afforded them. Under such circumstances, also, the administration of these remedies quickens the processes which are necessary to a cure. It has been found, for example, that the production of callus upon a fractured limb has been very imperfect, or even failed altogether, until the system felt the stimulus of alcoholic drinks. In like manner a tendency to *syncope* from other causes may be suspended by these stimuli. Every one is familiar with the powerful effect they produce in diminishing the sense of *fatigue* produced by prolonged muscular efforts. There seems to be no doubt that this property causes them to be sought for with so much avidity, and used to such excess, by people of the laboring classes.

It is unnecessary to repeat in this place what has already been said (see *Wine*) regarding the use of diffusible stimulants in *typhus fever*, and in typhoid affections generally, although very similar remarks might be made. In general, and for continued use, wine is greatly preferable to brandy or whiskey; but in the lower forms of adynamia the temporary employment of one of the latter articles is essential. When, too, the patient, as often happens in hospital practice, is accustomed to their use, it may be freely administered in the form of punch. In 1853, the late Dr. Todd[1] reported eighteen cases of typhus fever, the treatment of which consisted in administering, either every half hour or every hour, day and night, from half an ounce to an ounce of brandy, with a draught, every second hour, containing ten minims of chloric ether and five grains of carbonate of ammonia. Subsequently Dr. Todd and his disciples fell into the error of extending this treatment to all acute diseases. It was, in fact, a revival of the stimulant method, which, as an essential portion of the Brunonian system, held captive the judgment of physicians for half a century, and until its evil consequences prepared a way for the revulsion of opinion which culminated in that incongruous association of medicinal impotence and truculent waste of human life inaugurated by Broussais. Both

[1] Times and Gazette, Aug. 1853, p. 217.

were the fruits of theorizing, and of futile attempts to found the treatment of disease upon pathological hypotheses. Fortunately, at the present day, the influence of names and theories upon practice is less absolute than formerly; the teachings of experience, that is to say, the experience of the mass of the profession, outweigh the authority of the most eminent individuals, and doctrines have little chance of permanence which daily observation does not clearly confirm.

Dr. Todd's cardinal doctrine was the following: "All maladies should be regarded as more or less asthenic, and in their treatment an object of primary importance will be the early adoption of means to uphold the vital power, and the watchful and continued use of them throughout the duration of the case;" and he further maintains that the notion that acute disease can be "cured by means which depress vital and nervous power is altogether fallacious." To accept such dogmas obliges us to reject the division of diseases into sthenic and asthenic, which has been recognized and made a basis of treatment from the earliest epochs of medical history. This is not the place to describe the morbid types referred to; they are portrayed in every treatise on the Practice of Medicine, and are as opposite as light and darkness, or life and death. The natural crises of disease, consisting of evacuations of blood, bile, fæces, mucus, urine, and sweat, and which are accompanied by a subsidence of fever and other morbid phenomena, and which have been imitated by means of medicines, would cease to have any significance, and the treatment established to produce them would have to be considered not merely useless, but positively injurious. It is not correct to say that evacuant remedies are necessarily debilitating. Their quality in this respect is altogether relative, and dependent upon the morbid condition they are employed to relieve. Evacuations of blood and of serous effusions often directly preserve life by removing physical obstacles to the free play of the organs. Either the propositions quoted above are false, because they are contrary to universal experience; or else they are intended to refer only to a limited class of cases in which asthenia is primary and predominant, and in that case they are deceptive.

In consonance with these propositions, Dr. Todd ventured upon another which is, if possible, more directly than they in conflict with experience. He taught "that disease is not curable by the direct influence of any form of drug or any known remedial agent, excepting when it is capable of acting as an antidote, or of neutralizing a poison, on the presence of which in the system the disease may depend." It seems very evident that a particular class only of diseases was contemplated by the author of this remarkable dictum. Even if it were admitted to be applicable to the continued fevers and so-called zymotic diseases, it has certainly no applicability whatever to inflammatory affections whose mechanism must be the same wherever they are situated. The mechanism of a coryza, a bronchitis, or a simple diarrhœa, of a tonsillitis, a pneumonia, or a pericarditis, is supposed to be intelligible enough with-

out the intervention of any hypothetical poison, and it is difficult to believe that even Dr. Todd would have affirmed it to be an element of any of them, or that their treatment should consist in neutralizing it. It would seem that he constructed a general formula out of elements derived from a very small group of diseases, in which our ignorance of their mechanism makes it allowable to assume that their phenomena depend upon an occult morbid cause which we metaphorically call a poison. The doctrine which we oppose seems to exclude altogether that tendency to spontaneous cure and self-limitation which is the most familiar feature of acute diseases, and its manifest influence must be to make physicians meddlesome and officious and distrustful of Nature, while all the great masters of our art have inculcated reliance upon the natural powers and a cautious and gentle interference with their operations. There are, indeed, periods of time during which acute diseases of every sort assume an asthenic type, when evacuants are scarcely tolerated, and when alcoholic and other diffusible stimuli must needs enter into their treatment. But even here great discrimination is demanded. The safest practical rule is to avoid using them before they are clearly indicated. They then come into action with all the greater power that they have not been administered before they were needed. Employed earlier than this, they not only tend to aggravate the proper symptoms of the disease, but rapidly beget a tolerance of their action which may render them inert when their power could be exerted most advantageously.

It is fortunate that a record has been kept of the results of Dr. Todd's treatment of acute disease by alcohol, which when submitted to a careful scrutiny amply confirms the objections which, on general grounds, have been made against it. The mortality which attended the use of alcohol by him was greater than is presented in the records of hospital practice anywhere else, and was in precise proportion to the profuse employment of alcoholic stimulants. Indeed, the only parallel to its results is presented by the sanguinary system of depletion which Bouillaud advocated. It has been well remarked, that if the consequences of both seem to be less disastrous than could have been anticipated, the credit must be given to that sturdy and tenacious power with which animal life maintains its existence against external harm.

The propositions enounced by Dr. Gairdner respecting the use of alcohol in *typhus fever*, so nearly express the conclusions to which experience has led us in the treatment of typhoid fever, and of the typhoid state of other diseases, that we think no apology necessary for transcribing them in this place. 1. "It is possible to reduce the mortality of typhus fever, while withholding a large proportion of the amount of alcoholic stimulants usually given. 2. This diminution of mortality may take place at all ages, but is most marked amongst the young. 3. While at all ages the administration of stimulants ought to be very strictly guarded, as likely to prove injurious when in excess, it is demonstrable that young and temperate persons may be advantageously treated, *i. e.*, treated with a dimin-

ished mortality, without one drop of wine or spirits being given from beginning to end of the fever, except in the rarest casualties. 4. The principle of giving stimulants as a matter of routine in typhus, *i. e.*, at a certain stage of the disease with but little regard to individual peculiarities, ought to be at once abandoned."[1] Cases are, however, met with of *typhus fever* in which alcoholic drinks may be administered in doses so large that if given to the same individuals during health they would probably prove fatal, and yet they may occasion none of the symptoms of alcoholic narcotism, nor any sensible effects whatever except the sustenance of the patient's strength until the febrile attack exhausts itself. In some cases of this description the urine has furnished no sign of the presence of alcohol, proving conclusively that the stimulant had been appropriated usefully to the purposes of the economy. There is probably no other febrile disease in which the operation of alcohol is so apt to be salutary as this, for it is the only fever in which the highest grade of adynamic and atonic symptoms are apt to be dissociated from any local structural change.[2] In *typhoid fever* the issue is quite as often dependent upon the condition and course of the intestinal lesion as upon the state of the blood; and in the *eruptive fevers* local morbid elements frequently determine the result; but in either typhoid or eruptive fevers, or in inflammatory diseases, the chief indication for alcohol is to be found in a persistent and increasing tendency to coma or debility, or to both conjoined, and the surest evidence of its favorable influence is its diminution of that dicrotism of the pulse which is characteristic of low fever, and which depends both upon the impaired propulsive energy of the heart and upon the diminished contractility or tension of the arterial walls.

In the Introductory Chapter to the present Class of medicines the reader will find the general considerations which should govern the use of stimulants in acute diseases. In this place it is unnecessary to do more than renew the caution to restrict their use as much as possible to those conditions of exhaustion or depression which are of temporary duration; to limit the dose of them to the least quantity which will fully accomplish the object of their administration; and so to associate them with nutriment that not only shall the waste of the body be diminished, but its organic force increased.

[1] Lancet, March, 1864, p. 291.

[2] Dr. Murchison (A Treatise on the Continued Fevers of Great Britain, 2d ed. 1873, p. 280) suggests certain rules for the employment of alcohol in typhus fever, which may be thus epitomized: It is more useful in patients over forty than in younger ones; when the pulse is weak, irregular, and preternaturally frequent or slow, and wanting in force; when the eruption is dark, the perspiration profuse, the extremities cool, and the tongue dry and brown; when the typhous state (*i. e.*, stupor, low delirium, tremor, subsultus, involuntary evacuations, etc.) is present; when, as a rule, complications exist. It should always be given in divided doses, and especially between midnight and morning. It is contraindicated in young patients, as a general rule; when its administration quickens the pulse; when the skin is dry and hot; when it increases instead of allaying delirium; when there is severe, throbbing headache, and active delirium without much impairment of the force of the heart and pulse; when the urine is of low specific gravity, deficient in urea, or contains albumen, or when it is either scanty or suppressed.

A very eligible mode of administering brandy in asthenic and typhoid affections is in milk-punch, in which the relative proportions of the stimulant and of the nutritive elements can be varied according to the predominance of typhoid symptoms on the one hand, and of simple debility on the other. A mixture intended to fulfil similar indications is the *Potus analepticus* of Hufeland, which consists of the yelks of two eggs, an ounce of sugar, two ounces of brandy, two pints of water, and half a drachm of powdered nutmeg. Similar remarks would be applicable to those forms of *erysipelas* which tend to phlegmon, to carbuncle, and to moist gangrene.

Alcoholic liquors have occasionally been used to cure *intermittent fever* by placing the patient thoroughly under their influence in advance of the expected paroxysm.

In not a few instances of *chronic fluxes* of the mucous membranes, and particularly of the intestine, the well-guarded use of alcoholic drinks is often of essential service. Such are cases occurring in persons of relaxed fibre, and of a lymphatic temperament, or in whom protracted suffering and evacuations have exhausted the recuperative powers of nature. Here the best remedy of the stimulant class is good brandy, to the extent of from half an ounce to an ounce daily, beaten up with the white or yelk of an egg and powdered sugar.

A good deal of dry statistical labor and as much ingenuity of pathological reasoning have been expended to prove that alcohol is not and cannot be a suitable medicine in *pulmonary consumption.* An argument which to those who entertain this opinion appears unanswerable is that drunkards, as well as sober persons, die of the disease. When intemperance in alcoholic drinks shall be recommended by any one as a prophylactic against phthisis, it will be time enough to consider the force of such reasoning. All that the physician has to inquire is whether or not the medicinal use of alcohol promotes the cure of the disease, where that is possible, and mitigates its symptoms and prolongs the life of its victims when recovery is out of the question. To this there can be only one answer. Alcohol in appropriate forms, *i. e.*, as wine, brandy, whiskey, etc., according to circumstances, and applied exclusively to such cases as render it appropriate under the circumstances, is, *when it agrees with the patient*, a most valuable agent in the treatment of this affection. It sustains the strength during bodily exercise in the open air, which is the only remote agency by which phthisis is ever really cured; it stimulates the appetite and promotes digestion, which are the immediate means by which the blood is enriched and its quantity increased; and it both directly and indirectly imparts calmness and tone to the nervous system. It is very true that many consumptives, like many persons who are not so, cannot tolerate alcoholic stimulants. Feverishness, headache, indigestion, and sour stomach may follow their use in the smallest quantity. But these cases are exceptional, and the vast majority of persons affected with consumption find themselves improved by wine, or by malt or distilled liquors, *taken with their food.* To be used at

other times, when there is no accidental debility or other special indication to counteract, is to misapply and therefore to abuse them. As a vehicle for the administration of cod-liver oil alcoholic liquids are almost indispensable. Nothing so well conceals the disgusting savor of the medicine, and probably nothing is so efficient in promoting its digestion.

In *delirium tremens* alcohol acts as a specific cure. The earliest notice we have found of this use of the remedy is by Dr. Hausbrandt,[1] who employed it successfully in the case of a drunkard in whom the attack came on several weeks after his commitment to prison for theft. In this country it appears that it was occasionally used by New England practitioners in the treatment of the disease; but the first systematic demonstration of its superiority over other modes of treatment was given by Dr. Gerhard, who had a large field for the observation of its results in the Philadelphia Hospital, to which he was attached. He there showed that by substituting the alcoholic for the opiate treatment the mortality of the patients was reduced from ten to less than one *per cent.* In slight cases he prescribed an ounce of brandy every three or four hours; or, if the tremors were severe, the double of this dose. When patients had been used to inordinate quantities of alcoholic drinks, still larger doses were administered, as two ounces every two hours; but this amount was not continued for more than a single day, as a general rule.[2] Mr. Solly confirms this statement of the value which we attach to the method in question. He says: "The plan of treatment which I have found, on the whole, most successful in true delirium tremens is to give the stimulus which the patient prefers, from being more accustomed to."[3] In mild cases, we are of opinion that porter is preferable to distilled liquors, on account of the narcotic and tonic elements which it contains; and in many cases of this grade no treatment is necessary besides well-seasoned food and active exercise in the open air; but in severe ones the stronger preparations of alcohol are alone effectual. It has been objected to this method that it tends to foster the vice of intemperance. Whether or not the alternative proposition of leaving drunkards to die is more consonant with charity and duty, is a question which we leave to casuists to decide.

Alcohol may be used as an antidote to *narcotic poisoning*, by opium, digitalis, tobacco, etc., although there are few toxicological writers who allude to this employment of the remedy, which is of common use by Italian practitioners. There would seem to be some reason for believing that it is really indicated in the state of depression produced by these agents. The power it has of neutralizing the effects of tobacco fumes is familiar to all smokers; and a case is on record in which a patient appears to have been snatched from profound narcotism by the administration of brandy.[4] The

[1] Rust's Magazin, 1826; and Journ. des Progrès, i. 268.
[2] Library of Pract. Med. (Am. ed.), ii. 245.
[3] The Human Brain (Am. ed.), p. 280.
[4] Shephard, Medical Repository, iv. 347.

same remedy has sometimes been found effectual as an antidote to the poison of *venomous serpents*. Cases of this sort have been published by Ramsey and by Mayrant, in which large doses of brandy saved the patient's life.[1] Dr. Gilman, of St. Louis, asserts that alcohol, if brought in contact with the venom, is, to a certain extent, an antidote; but Breschet[2] and Pravaz state that the poison, preserved in alcohol, loses none of its deleterious qualities.[3] Dr. S. W. Mitchell also concluded from his experiments that alcohol is to be looked upon merely "as a stimulus to be employed to buoy the patient over the prostration caused by the venomous poisoning."[4]

In *traumatic tetanus* the curative effects of wine have been already noticed. In one of the cases of cure reported by Mr. Curling in his work on tetanus, brandy and porter were used, besides large quantities of wine. A similar result was obtained by Mr. Stapleton with large doses of alcohol,[5] and by Mr. Ilott with wine and brandy as the chief remedies.[6]

Anstie has called attention to the efficacy of alcohol in warding off attacks of paroxysmal nervous affections.[7] In small or stimulant doses it often exerts a powerful effect in averting threatened *epileptiform attacks*. The danger of its abuse must not, however, be forgotten. The effect of alcohol, says the same author, in arresting the *convulsions of teething*, is one of the most remarkable instances of a real therapeutic influence which can be witnessed. A minute dose is amply sufficient for any good purpose that can be effected. In acute *neuralgia*, he further remarks, "it has happened to me several times to observe, that after large doses of various narcotics had been tried in vain, the first real and substantial relief was obtained by the use of a moderate dose of alcohol. The consequence of overdoing the remedy is, however, nearly always disastrous."

The *vomiting of pregnancy* is said by Pigeaux generally to yield to the administration of a small glass of brandy, taken at meals, which, he recommends, should consist of substantial food.[8]

In two cases of *general dropsy*, occurring in drunkards, and following their abstinence from stimulating drinks, Brierre de Boismont found a cure in the use of alcoholic liquors. In one of these cases delirium tremens and dementia, and in the other acute mania, preceded the appearance of the dropsical effusion.[9]

Externally, alcohol and its preparations are employed as styptics, astringents, and stimulants. Anciently, wine alone, or with oil, was the ordinary dressing of *wounds*, as numerous passages of sacred and profane history attest; and a great number of vulneraries, which, after having been long used by physicians, have fallen into the domain of popular and domestic medicine, owe whatever virtues they possess, as much to their alcoholic solvent as to their resinous,

[1] American Medical Recorder, vi. 619.
[2] Charleston Journ., ix. 510.
[3] Annales de Thérap., ii. 273.
[4] N. Am. Med.-Chir. Rev., v. 269.
[5] Lancet, March, 1845, p. 317.
[6] Ibid., May, 1845, p. 648.
[7] Stimulants and Narcotics (Am. ed.), p. 371.
[8] Bull. de Thérap., iii. 134.
[9] Annuaire de Thérap., 1845, p. 101.

acrid, or anodyne ingredients. In 1859, and more recently, alcohol has been used as a surgical dressing by Batailhé, Dolbeau, Nélaton, and others, and, it would appear, with marked advantages over the ordinary method, especially as regards simplicity, cleanliness, and comfort to the patient. It is said to promote the exudation of plastic lymph, and protect the raw surface by coagulating the albumen which bathes it, to favor union by the first intention, diminish suppuration, prevent the usual fetor of even healthy wounds, lessens the chances of pyæmia, etc. The dressing should consist of charpie saturated with alcohol or with camphorated spirit, and covered with impermeable cloth.[1] From its power of coagulating the blood, diluted alcohol has sometimes been found serviceable as a *vaginal injection* in cases of *passive hemorrhage* from the womb. It is a popular and useful application to all recent *excoriations*, *bruises*, and *sprains;* it forms the best lotion for parts of the *skin* subjected to *pressure in bed* during long confinement by surgical injuries, or by fevers of a typhoid type. *Ulcers* resulting from pressure directly, or with the intervention of gangrene, and those of an equally atonic character produced by frost-bite, are generally improved by poultices containing alcohol; in this case, however, the fermenting poultice made with porter is to be preferred. Brandy is used with great advantage to prevent *fissure of the nipples* after childbirth in women who are subject to this accident. In the latter case it should be applied daily for some time before confinement, and rendered more efficient by the addition of a small portion of alum or tannin. It is very useful as a preventive of *excoriation of the feet* by walking, and also to relieve their soreness after prolonged exercise. During recovery from paralysis, its use in frictions of the *palsied limbs* tends to hasten the development of the muscles.

Superficial and recent inflammations of all kinds are frequently cured by weak lotions of brandy, or of alcohol and water. Thus, a mixture of one part of brandy with fifteen or twenty of water has been found effectual in arresting slight attacks of *acute conjunctivitis* when applied in the forming stage. Light compresses, wet with diluted alcohol, form an agreeable dressing for recent and superficial *burns*, in consequence of the cold produced by the evaporation of the liquid. For the same reason similar dressings are of use in all other cases of superficial inflammation, and are peculiarly so when it is desired to moderate vascular action in the head in *cerebral inflammation*, *fevers*, *headache*, etc. On the other hand, the irritant action of the remedy may be had recourse to in the treatment of chronic *urethral discharges*, to induce adhesive inflammation in the tunica vaginalis testis after the operation for *hydrocele*, etc. In like manner the inhalation of alcoholic vapors has been employed to cure *chronic bronchitis.*

Antidotes.—The best remedy for alcoholic intoxication is an

[1] Chédevergne, Bull. de Thérap., lxvii. 249; Marvy, Arch. Gén., 6ème sér., v. 619.

emetic. Vomiting, indeed, often forms the natural cure. Its operation is not confined to voiding the stomach of its poisonous contents. This effect is certainly the most important when a short time only has elapsed since the liquor was swallowed; but after the complete absorption of the poison, and even after its secondary effects are developed in the form of mania or delirium, this remedy continues to be the most effectual. It produces relaxation, while more than anything else it soothes nervous agitation, and disposes to sleep. When the symptoms are those of profound intoxication, when the patient is not only "dead drunk," but utterly insensible, with dilated pupils, and turgid or else sunken features, he is, of course, unable to swallow, and generally the stomach-pump must be used. Afterwards, an emetic of *mustard* should be given by the same instrument, if the patient is still insensible. This is more effectual than sulphate of copper or sulphate of zinc; and tartar emetic is on no account to be employed. In milder cases ipecacuanha is admissible. At the same time the head should be elevated, all pressure removed from the neck, and cold applications, particularly a stream of cold water, directed upon the head. Bloodletting is very rarely admissible, and is, perhaps, never advisable. Dry cups to the temples and nuchæ may, however, be directed. When once the threatening symptoms have passed away, the patient should be allowed to rest, for sleep will complete the cure. Milder forms of alcoholic intoxication are more speedily relieved by the preparations of *ammonia* than by any other means. We have repeatedly known a person, who was lying apparently quite unconscious and insensible, to rise and walk away after the administration of ten or twelve drops of the water of ammonia. The fumes of this preparation alone have often a very rapid effect. The acetate, the carbonate, and also the aromatic spirit of ammonia are said to be equally efficacious. Acids, such as vinegar and lemon-juice, and also saline substances, such as smoked beef, olives, etc., are reputed to be capable of diminishing the effects of alcohol.

OLEUM TEREBINTHINÆ.—Oil of Turpentine.

Description.—Oil, or as it is most commonly called, *spirits* of turpentine, is a volatile oil procured by distilling the sap of certain coniferous plants, and in America particularly *Pinus palustris*, *P. tæda*, and other species of *Pinus*. In this country it is chiefly produced in North Carolina.

Oil of turpentine is a colorless liquid of a peculiar odor and a burning, pungent, and unpleasant taste. Its sp. gr. is 0.86, and its boiling point about 314° F. It is very slightly soluble in water, but readily dissolves in ether. Boiling alcohol takes up a certain proportion of the oil, most of which, however, it deposits upon cooling. One hundred parts of alcohol of sp. gr. 0.84 dissolve thirteen or fourteen parts of this oil, and absolute alcohol a still larger quantity. By exposure to the atmosphere it becomes oxidized,

and, owing to the formation of resin, becomes thicker and also yellowish.

History.—In the Hippocratic writings, young pine shoots or cones are recommended in amenorrhœa, and in various uterine affections. Pliny describes several varieties of turpentine, and speaks of their use for coughs and ulcerated bowels; their resins he mentions as suitable to promote the healing of sores, and as ingredients of ointments intended to give suppleness and strength to the limbs.[1] He, and also Celsus, refer to their diuretic properties. Similar statements are made by Dioscorides.[2] In the sixteenth century Fernel described the properties of turpentine as follows: "Terebinthina calefacit, mollit, discutit, tergit, expurgat: viscerum omnium, maximeque renum, obstructiones tollit, et angustos meatus aperit, urinam ciet, putredinem cohibet."[3]

The earliest reference which we find to the *oil* of turpentine is that made by Pomet (1692), who states that it is procured by distillation in the neighborhood of Marseilles and Bordeaux, and styles it a truly natural balsam proper for all kinds of fresh wounds.[4] Its use as an internal remedy did not become general until the last century, when it was recommended by Boerhaave and others for chronic affections of the lungs and bowels, and various other diseases in which it was also customary to prescribe turpentine itself. These, as we find them stated by Hoffmann,[5] were gonorrhœa, leucorrhœa, and calculous, gouty, and rheumatic affections. It was also employed as a purge, as a diuretic, and as a vulnerary. The author just mentioned refers to the use of the oil of turpentine as a medicine to be used with extreme caution, on account of its heating and irritating properties.

Action. *On Animals.*—Hertwig injected a drachm of oil of turpentine into the veins of a horse. Immediately the heart's action became irregular, and then ceased to be felt; the breathing was hurried and labored; the nasal mucous membrane was red and dry, and the breath of the animal smelled strongly of the oil. He had, besides, a vacant and dull look, and urinated frequently; but he soon recovered. In an experiment of Schubarth, two drachms of the oil were given to a dog, destroying its life in three minutes, with signs of great suffering.[6] In small doses the oil appears to excite the appetite and increase the secretions of the liver, bowels, and kidneys. Somewhat larger doses occasion colic, diarrhœa, hurried breathing, and arterial excitement, with an increased secretion of urine, which is sometimes tinged with blood. Mitscherlich's experiments showed that an ounce of the oil would destroy a large rabbit within forty-four hours, and half an ounce in sixty hours. The odor of turpentine was detected in the breath, and, after death, in the peritoneal cavity. The direct symptoms produced were great restlessness, a frequent pulse, and hurried breath-

[1] Hist. Nat., xxiv. 22.
[2] Mat. Med., lib. i. ch. 76, 77.
[3] Opera, i. 444.
[4] Hist. des Drogues, p. 287.
[5] Oper. Omnia, Suppl., i. 744.
[6] Wibmer, Wirkung, etc., iv. 212.

ing, which lasted for two hours, and were followed by a copious secretion of urine exhaling the characteristic violet odor, and also by diarrhœa. The animals then appeared to be exhausted, and died without convulsions. No inflammation of the stomach or intestine was found. In the former organ were observed numerous flattened particles of blood as large as a pin's head or a flaxseed. They had stained the mucus of a brown color. The other organs were not materially changed.[1] Hertwig found that the oil, when rubbed upon the shaven skin of a horse, imparted its characteristic smell to the breath, and increased the discharge of urine. When applied to a wound or to the denuded cutis, it occasioned signs of pain followed by inflammation.

Liersch confined rabbits, cats, and dogs successively in boxes partially open for the admission of air, and whose sides were coated with oil of turpentine. The animals manifested the following symptoms: restlessness, dulness, staggering, and giddiness, and loss of power, especially of the hinder limbs, partial or general convulsions, laborious respiration, and rapid movements of the heart; symptoms very analogous to those occasioned by carbonic acid. The conclusion was that the toxical operation was not merely asphyxiating, but also neuroparalytic.[2]

On Man.—If the back of the hand be kept moistened with oil of turpentine, a pricking sensation is experienced in about five minutes, and, in ten minutes more, a burning pain with moderate redness of the skin. If the application be continued for half an hour, the pain is very severe, and sometimes vesication follows. When terebinthinate vapors are *inhaled*, the specific effects of the medicine are produced. This is observed in the case of sailors on board of vessels laden with spirits of turpentine, and of persons employed to unload them, particularly during warm weather; in that of operatives in manufactories of India-rubber where *camphene* (purified oil of tar) is used as the solvent of this substance, etc. Such persons are very apt, particularly at first, to suffer from nausea, vertigo, impaired vision, pain in the back and loins, strangury, bloody urine, insomnia, malaise, and an eczematous eruption. The females, in addition, are often affected with menorrhagia or dysmenorrhœa.[3] Bouchardat describes his having experienced similar symptoms in consequence of exposure to the vapors of turpentine.[4] In the case of a young lady reported by Favrot, the symptoms resembled those of the stage of collapse in cholera, except that there was no diarrhœa.[5] The direct inhalation of terebinthinate vapors is said to produce an anæsthetic effect. They have been employed for this purpose in surgical operations.[6] The following are the phenomena produced by oil of turpentine when taken into the

[1] Lehrbuch, ii. 253. [2] CASPER'S Vierteljahrs., xxii. 232.
[3] MATTHEWS, Am. Med. Recorder, xiv. 75; E. HARRIS, N. Y. Journ. of Med., N. S. x. 38. For its action on the nervous system, see HOPPE, Journ. f. Pharm., i. 105, 157.
[4] Annuaire de Thér., 1846, p. 66. [5] Edinb. Med. Journ., iii. 1144.
[6] Lancet, Mar. 1861, p. 227.

stomach, as described by Dr. Copland. This physician took ten drachms of the oil in coffee, and upon an empty stomach. His pulse rose from 69 to 80, and he experienced slight vertigo and chilliness, with heat in the stomach. After an hour, the vertigo and chilliness became greater, the countenance was pale and sunken, there was some confusion of mind, with increased gastric warmth and a sense of constriction in the bowels. The thirst and appetite were increased. The urine was more abundant and had an odor of violets, and for twenty-four hours the breath smelled of turpentine. The bowels were not moved.[1] According to the same authority, when the dose is large and is given during a febrile disorder, it reduces the frequency and strength of the heart's action. Hence he considered that it should tend, as in fact it appears to do, to diminish the effusion of coagulable lymph, in inflammatory disorders.[2] According to Dr. Thomas Smith, it sometimes produces copious diaphoresis with an itching eruption of the skin.[3]

At the issue of the third edition of this work (1868) there was but one well-authenticated case on record of death occasioned by the oil of turpentine. It was reported by Dr. Maund.[4] A female of intemperate habits swallowed an unknown quantity of oil of turpentine, which may have amounted to six ounces. She was found dead, her body in a state of opisthotonos, and very rigid. The eyes were open, and the pupils dilated. The brain, lungs, stomach, and both sides of the heart were gorged with dark blood, and six drachms of the oil were obtained from the stomach. Since then another case has been reported by Mr. Miall.[5] An infant, fourteen weeks old, swallowed half an ounce of oil of turpentine given it by its brother. In about an hour it became insensible, cold, and slightly convulsed; two hours afterwards the pupils were contracted, the pulse small and feeble, breathing very slow and irregular, and accompanied with moist pulmonary râles. Death took place at the end of about fifteen hours. In other cases, alarming symptoms have sometimes been observed. One is on record in which two drachms of the oil brought on strangury and bloody urine; then its total suppression, with fever, violent thirst, and vomiting.[6] Dr. Smith, above referred to, relates that half an ounce, given to a boy sixteen years of age, produced a tendency to somnolency and profuse diuresis, and his breath smelled of the medicine for upwards of a week. The following case is related by Dr. Harris: A boy three years old drank nearly *six ounces* of camphene. Within an hour and a half he was in a state of profound coma, the eyes suffused and injected, the pupils dilated, the pulse 130, the skin dry and hot, the mouth and fauces red and parched, the features somewhat contracted and anxious, and

[1] Lond. Med. and Phys. Journ., xlvi. 107.
[2] Dict. of Pract. Med. (Am. ed.), ii. 81.
[3] A Practical Treatise on the Therapeutic Uses of Terebinthinate Medicines, London, 1850.
[4] Glasgow Med. Journal, April, 1857.
[5] Lancet, March, 1869, p. 360.
[6] Edinb. Med. Essays and Obs., 2d ed., ii. 43.

the respiration hurried. The abdominal muscles were very tensely contracted, as he lay curved, with his arms closely folded and pressed on his abdomen. . . . . The child could not be kept awake, even while vomiting. There was constant priapism, with frequent attempts at micturition; but only four ounces of urine, and that bloody, were passed during eighteen hours, for which time the coma continued. For several days the patient remained excessively nervous and irritable, but at the end of a week he appeared to be well.[1] A case in which the symptoms closely resembled these, and which also occurred in this country, is quoted by Dr. Taylor.[2] In it the quantity swallowed was four ounces, and the patient was an infant of *fourteen months*, yet recovered. A curious statement is made by Roche, on the authority of Thénard. A lad was nearly asphyxiated by the air of a cellar in which turpentine was stored. On analysis of this air, it was found to be nearly deprived of its oxygen.[3]

Uses. *In Hemorrhage.*—John Hunter is one of the oldest and weightiest authorities upon this point. He says: "I have seen it immediately stop *vomiting of blood* from the stomach after all other means had failed, given internally with the white of egg as often as the stomach would bear it. In external hemorrhages, where it had not the desired effect applied externally, I would give it internally. It is the best, if not the only, true styptic. Thus, in a case of nasal hemorrhage which nothing would stop, I gave ten drops of oil of turpentine in a draught, and repeated it every two or three hours, which entirely stopped the bleeding, and it never returned."[4] Adair relates a case of its arresting hemorrhage from the bowels;[5] and Matthews, of Philadelphia, two similar cases.[6] Percy used it successfully in various forms of passive hemorrhage, and particularly *hæmaturia* and intestinal hemorrhage in typhoid fever. Its action he found to be less marked in organic affections of the womb and lungs, as well as in ordinary menorrhagia.[7] Mr. Vincent, of Dublin, found it efficient in the hemorrhagic diathesis, both when given internally and when applied as a styptic.[8] The remedy is undoubtedly most efficient in bleeding from the bowels and urinary passages, and from the external surface of the body, because probably, it here comes into most immediate contact with the affected part. Yet there can be no doubt that it exerts a real influence even upon hemorrhages less directly exposed to its operation. Thus, in addition to the illustrations already cited, Dr. W. Budd speaks of its great use in severe *menorrhagia*, and refers to a series of cases published by Mr. Griffiths, from which it would appear, that, in the dose of from half an ounce to an ounce, this oil

[1] N. Y. Journ. of Med., N. S., x. 40.
[2] On Poisons (Am. ed.), p. 426.
[3] Br. and For. Med.-Chir. Rev., Oct. 1856, p. 529.
[4] Works (Am. ed.), i. 304.
[5] Med. Facts and Obs., iv. 25.
[6] Am. Med. Recorder, xiv. 75.
[7] Am. Journ. of Med. Sci., Oct. 1848, p. 446.
[8] Ranking's Abstract (Am. ed), vii. 118.

often succeeds in arresting hemorrhage after parturition.[1] As regards the latter cases, it may be surmised that the remedy acted by exciting uterine contractions, as it is known to do, as well as by its styptic powers. Dr. T. Smith, of Cheltenham, also lauds its powers in all forms of internal hemorrhage; but, as he apparently associated with it other remedies of still more obvious efficacy, his eulogy can hardly be accepted without reserve.[2]

In *purpura hemorrhagica* the curative powers of this remedy are often decided. Thus, as early as 1821, Nicholl reported several cases cured by it;[3] Magee, also, a case of cure, in which the patient, a child of only six years, took every day for four days in succession, half an ounce of oil of turpentine, with an equal quantity of castor oil.[4] Dr. W. Budd refers to an aggravated case in a female sixty years old, in whom the application of the oil arrested bleeding from sloughing ulcers of the mouth, and the administration of ten minims of it every six hours, was followed by immediate amendment.[5]

Puerperal Fever.—Oil of turpentine appears to have been first recommended for this disease by Brennan, of Dublin, in 1814. He administered it in tablespoonful doses, and applied it as an epithem to the abdomen. He attributed the happiest results to its use.[6] Dr. Kinglake ascribed its success, which appears unquestionable, to the large doses of it exhibited.[7] Dr. Atkinson also published a favorable account of its effects.[8] Dr. Payne, of Nottingham, describing a case of the disease, says: "Although the patient was in *articulo mortis* at the time of the exhibition of the turpentine, she recovered very quickly; and the same success has attended the treatment with turpentine of every case of puerperal fever that has, within the last seven or eight years, fallen under my care."[9] Dr. Douglas, of Dublin, regarded it "as more effectually remedial than any other medicine yet proposed," and averred that under its use he had seen women recover after every hope of recovery, under ordinary treatment, had been relinquished.[10] Dr. Kinneir, without thinking that in the early stage of a majority of instances it ought to supersede the lancet, yet regarded it as a medicine of singular efficacy in this disease. He strongly advised fomenting the abdomen with the tepid oil, and he states that the patients expressed in the most forcible terms the extraordinary and almost instantaneous diminution of pain they experienced from its application.[11] Dr. Johnson, of Charleston, S. C., has reported four instances of the cure of "puerperal fever," in which two drachms of this medicine, with an equal quantity of castor oil, were given every hour until free evacuation of the bowels took place.[12] A case, with a similar

[1] Med. Times, Aug. 1850; and Am. Journ. of Med. Sci., Oct. 1850, 473.
[2] Lond. Journ., April, 1850; and BRAITHWAITE's Retrospect (Am. ed.), xxi. 416.
[3] Edinb. Med. and Surg. Journ., xviii. 541.
[4] Ibid. xxiv. 307.
[5] Loc. sup. cit.
[6] Lond. Med. and Phys. Journ., xxxii. 403.
[7] Ibid., xxxiii. 181.
[8] Ibid., p. 447.
[9] Edinb. Med. and Phys. Journ., xxxii 539; and ibid., xxii. 53.
[10] Dublin Hosp. Rep, 1822.
[11] Lond. Med. and Phys. Journ., liv. 33.
[12] N. Am. Med. and Surg. Journ., vii. 306.

result, was reported by Dr. Lucas, of Madison, Ga.[1] Bonfils reports cases cured by opium and oil of turpentine used conjointly as recommended by Trousseau.[2] Rauch, of Berlin, has also published one in which the medicine appears to have arrested and cured the disease after the failure of the antiphlogistic method.[3]

Such numerous and varied authorities would perhaps have better established the efficacy of oil of turpentine as a remedy for childbed fever, had it been certain that they all referred to the same disease. Of this the proof is by no means clear. Some cases were evidently examples of that blood-disease which is, *par excellence*, puerperal fever; others were perhaps cases of peritonitis; and others, again, instances of that mere tympanitic distension of the bowels which is independent both of inflammation and of pyæmia, but which is not unfrequently treated as if it were one of these. The small credit which the terebinthinate method now enjoys can only be accounted for by supposing it to have been found unsuccessful; for, in a disease which usually destroys one-third of all that it attacks, a really efficacious method would not have been allowed to fall into neglect. The more eminent accoucheurs express no faith in its efficacy, or else accord to it but little more than a negative value. Thus Blundell does not think that it aggravates the symptoms, and Dr. Meigs finds no objection to its use, "seeing that the inconveniences of the practice are null, and that certain persons do appear to have been rescued by it from dangerous extremity."[4]

Yellow Fever.—The styptic and stimulant properties of oil of turpentine led probably to its use in yellow fever, first, to arrest gastric hemorrhage, and then to give the system energy sufficient to carry it safely through the disease. It was first used by Dr. Physick, of Philadelphia, in 1798. He discovered, says Rush, that ten drops of the spirit of turpentine given every two hours effectually checked the vomiting, in several instances, in patients who afterwards recovered.[5] It was also used by Drs. Chapman, Hewson, Jackson, and others, of the same city, during the epidemic of 1820, and in the same year by Drs. Waring and Kollock, of Savannah, but in all of these cases without decidedly favorable results. Meanwhile it appears to have been employed in 1817, by Dr. Copland, during the prevalence of the disease on board a ship in which he was a passenger from Sierra Leone to Cape Coast Castle,[6] and was subsequently recommended by him in his Dictionary of Practical Medicine,[7] where he speaks of it as certainly beneficial when given during the stage of excitement as a purge, conjoined with other oils, and also during the stage of exhaustion as a styptic and stimulant in smaller and more frequent doses. In a letter addressed to him by Dr. A. Smith, a practitioner of Peru, the turpentine treatment is spoken of as "signally successful" among the Indians suffering from yellow fever.[8] The remedy has also been used by Dr. Gilbert

[1] Am. Med. Recorder, vi. 615.
[2] Bull. de Thér., liv. 433.
[3] Archives Gén., 2ème sér., xiii. 105.
[4] On Childbed Fevers, p. 321.
[5] Works, iv. 96.
[6] Times and Gazette, May, 1855, p. 472.
[7] Amer. ed., iii. 209.
[8] Times and Gaz., loc. sup. cit.

King, of Bermuda, and Mr. Laird, R. N., first with a view of restraining passive hemorrhage, and afterwards as a general stimulant, and for promoting the secretions of the skin and kidneys. Mr. Laird states that whereas the rate of mortality in 164 cases treated without turpentine was 1 in 6.6, it was only 1 in 8.6 of the same number to whom this medicine was administered.[1]

Typhoid Fever.—In 1826, Dr. Wood, of Philadelphia, originally drew attention to the use of spirits of turpentine in "a particular condition of fevers,"[2] marked during the decline of the attack, with sudden dryness of the tongue, tenderness and slight distension of the abdomen, a frequent and feeble pulse, wandering intellect, and an anxious suffering expression of countenance. Under the use of ten or fifteen drops of oil of turpentine, frequently repeated, these symptoms, which other stimulants were found to aggravate, began rapidly to decline, and convalescence shortly ensued. Dr. Wood's subsequent experience,[3] and, we may add, that of other physicians, tended to confirm the original conviction, that the medicine is effectual as a remedy for the conditions of typhoid fever above described. Its mode of action appears to be, locally, that of a healthful excitant of the muscular coat of the intestine favoring its contraction, and of the intestinal ulcers, promoting their cure; and at the same time that of a genial stimulant of the whole economy. For these reasons we apprehend that its administration is especially called for when the tympanitic distension of the abdomen is most marked, whatever may be in other respects the state of the patient.

In certain *intestinal fluxes* it was recommended by Chapman, and particularly in *dysentery* "when gangrene is menaced," and in *cholera infantum* at a stage somewhat earlier; in *chronic diarrhœa*, he adds, with such discharges as denote the mucous coat of the intestines to be chiefly affected, "it is an incomparable remedy."[4] According to Kinglake, Vogt, and Paris, it is equally efficient in *obstinate constipation* attended with tympanites, vomiting, and pain. In such cases it should be given in the dose of half an ounce with an ounce of castor oil. In flatulent distension of the bowels, and particularly of the colon, no other remedy is so effectual, whether it is administered by the mouth or by the rectum. In the latter case an enema may be used consisting of from half an ounce to an ounce of the oil mixed with flaxseed tea or other similar excipient.

Intestinal Worms.—This oil is justly considered one of the most efficient among vermifuge medicines. Long since, Malden,[5] and afterwards Fenwick[6] and Chisholm, reported its success in England against *tænia*, and in this country Dr. Hayward published a case of cure in 1819.[7] But not to dwell on particular instances, reference may be made to the summary of experience on the subject furnished by Bayle,[8] from which it appears that out of eighty-nine cases re-

[1] Lancet, Aug. 1853, p. 183; Times and Gaz., Apr. 1855, p. 358, Jan. 1856, p. 45.
[2] N. Amer. Med. and Surg. Journ., i. 272.
[3] Practice of Medicine, 4th ed., i. 346.
[4] Therapeutics, ii. 89.
[5] Mem. of Med. Soc. London (1795), iv. 419.
[6] Med.-Chir. Trans., ii. 24 (1810).
[7] N. Eng. Journ., viii. 109.
[8] Bibl. de Thérap., iv. 555.

ported by various authors, seventy-seven were cured, eight were improved, and in four only was the remedy inefficient. Large doses of the oil were generally given, that is to say, from half an ounce to two or three ounces. In most cases the worm was discharged dead. It has also been successfully used for the destruction of *lumbrici* and *ascarides*.[1] Dr. Klapp, of Philadelphia, found it very effectual in destroying worms in the stomach, and removing symptoms attributed to them, even when none of their remains could be detected in their evacuations. He directed it to be given in doses of from six to twelve drops three times a day.[2]

Biliary Concretions.—The use of oil of turpentine in cases of this affection was first proposed by Vallisneri, and afterwards, in 1792, by Durande, of Dijon, who reported seven cases of its complete success. He made use of a mixture, sometimes of equal parts of the oil and sulphuric ether, and sometimes of two parts of the former to three of the latter article. Of this a teaspoonful was to be taken every morning, fasting, and followed by a glass of whey or other diluent.[3] Its good effects were also attested by Sœmmering, Richter, and other eminent physicians.[4] More recently Martin-Solon has published a marked case of its success.[5] Some authorities contend that the medicine acts as a solvent of the concretions in the gall-bladder or ducts, while others deny this operation, and refer the effects observed to an excited peristaltic action communicated from the duodenum to the gall-ducts.

Oil of turpentine, in consequence of its diuretic properties, may be employed in *dropsy* when a direct action upon the urinary organs, and especially upon the kidneys, involves no danger. It may be given internally, or applied by friction to the loins. It has sometimes been used to promote the discharge of small *calculi*.

In debility or paralysis of the bladder, with incontinence or retention of urine, it is a very efficient remedy. Dr. Elliotson used terebinthinate enemata successfully in some obstinate cases of *amenorrhœa*, apparently connected with local causes, and independent of anæmia. After prescribing the loss of twelve ounces of blood by venesection, he directed an enema to be administered consisting of half an ounce of the oil in a pint of barley water. Stimulating clysters have been advised by Ramsbotham and others to re-excite *uterine contractions* when they have ceased during labor, and those containing oil of turpentine are probably the best.

Murray states[6] that oil of turpentine taken in honey had long been used by the vulgar as a domestic remedy for *sciatica* and *rheumatism*. In 1780 Home testified to its efficacy by the publication of seven cases cured by its means. Cheyne also recommended it as "a perfect cure for sciaticas" when taken in doses of half an ounce at bedtime, during four or from that to eight days.[7] In France it

[1] Rumsey, Med.-Chir. Trans., ix. 402; Kennedy, Lond. Med. Repos., Feb. 1823.
[2] Amer. Med. Record., iii. 155.
[3] Bayle, op. cit., iv. 507.
[4] Dict. en 60 vol., iii. 464.
[5] Bull. de Thérap., xxxvi. 297.
[6] Apparat. Medicam., i. 27.
[7] Lewis, Mat. Med., ii. 419.

was first recommended by Recamier, and afterwards by Martinet.[1] The latter employed it very extensively and with great success. He states that when administered in cases of sciatica it produces a sense of heat in the stomach, which also extends itself along the affected nerve, and that its beneficial effects are usually experienced within three or four days. If no improvement took place within a week, he deemed it unnecessary to prolong the use of the remedy. In his hands the oil effected a cure of fifty-eight out of seventy cases of sciatica, and was given in doses of not more than thirty drops three times a day.

Other proofs of its curative powers are reported by Rayer,[2] who used it also in *facial neuralgia*, and by Laroque, Dufour, etc.[3] It was prescribed as a remedy for *epilepsy* by Latham,[4] under the impression that in certain cases the disease might depend upon worms or foul bowels as a cause. Percival[5] effected only a temporary cure by its use, in three female patients; and Lithgow[6] was not much more successful.

Oil of turpentine was recommended by Carmichael in the treatment of *syphilitic iritis*, and other deep-seated inflammations of the eyes, in the dose of a drachm three times a day. In iritis he did not regard it as superior to mercury, or even of equal efficacy, but looked upon it as a valuable resource in cases which do not admit of the mercurial treatment. There is some reason to believe that its benefits, such as they were, depended upon its purgative operation. This, however, is not the opinion of Flarer, an oculist of Pavia, who asserts that the remedy subdues the local pain, congestion, and lachrymation, even when it confines the bowels.[7] Inhalation of the vapor of this medicine has been proposed by Skoda in the treatment of *pulmonary gangrene*. He reports four cases in which it proved efficacious. In one of them only is the frequency or extent of its use intimated, and in that the inhalation was employed every two hours for five or ten minutes at a time. We have frequently used it in atomized inhalations for the cure of *chronic bronchitis*, and always with advantage.

Phosphorus Poisoning.—It is said that in a manufactory of lucifer matches, at Stafford, Eng., the workmen are protected against the poisonous fumes of phosphorus by wearing an open vessel containing oil of turpentine, suspended around the neck. But the first instance of this oil being administered for the purpose of preventing the effects of phosphorus taken internally appears to have been recorded by Dr. Andant, formerly an apothecary of Paris.[8] A man swallowed the ends of a boxful of blue phosphorus matches with suicidal intent, and thinking to render his purpose more sure, took immediately afterwards a mouthful of oil of turpentine mixed with water. After an hour or two finding that no effect was produced, he used

[1] Thèse, sur l'emploi, etc., 1818; Mémoire, etc., 1824 and 1829.
[2] Med. and Phys. Journ., lxv. 45.
[3] Bayle, op. cit.
[4] On Diabetes (1811), p. 241.
[5] Edinb. Med. and Surg. Journ., ix. 271.
[6] Ibid., xi. 300.
[7] Bull. de Thérap., xiii. 269.
[8] Ibid., lxxv. 269.

two other boxfuls of matches in the same manner. He suffered from heat in the mouth and intense thirst and headache, but not from abdominal pain, and recovered without serious symptoms. A few months afterwards the same physician was called to see a woman who had taken about a dozen non-explosive matches, also with a suicidal intention. She soon experienced severe pain, with spasms, burning in the throat, intense thirst, etc. About fifteen drops of oil of turpentine in mucilage were administered every quarter of an hour, until four doses were taken. Within two hours she was much better, and the next day nearly free from uneasiness.[1] Dr. Sorbets reports a case in which several persons were poisoned by eating pork in which three bundles of phosphorus matches had been concealed for poisoning rats. Turpentine was promptly administered, and they all recovered.[2] In the case of a girl who swallowed the ends of eight matches, and suffered abdominal pain and vomited matters tinged with blood, Lichtenstein administered twelve drops of oil of turpentine, with the effect of almost immediately allaying the pain, and the vomiting soon afterwards.[3] A case is reported by Köhler of a woman who dissolved about two hundred match tips in five or six cupfuls of water, of which she swallowed a cupful every morning until the fourth day, when she finished the poisonous draught, and was seized with the fully developed symptoms of acute phosphorus poisoning. Turpentine was administered an hour later, and immediately the symptoms began to subside, and in four days she was fully restored.[4] Two other cases are furnished by Andant. In one a woman swallowed a portion of thirty or forty match ends dissolved in soup, of which she ate largely, and her husband and son sparingly; they were comparatively but little affected, but she had very grave symptoms, over which, however, the oil of turpentine seems to have triumphed.[5] The other case took place in China, where a native woman employed the same means of attempting suicide, and suffered severely with the characteristic symptoms of phosphorus poisoning. She was immediately relieved by the administration of oil of turpentine.[6]

In order to test the value of the supposed antidote, Personne performed a series of experiments upon dogs.[7] He gave equal doses of phosphorus to fifteen dogs divided into three series of five each. To the first five no turpentine was given, and they all died; to the second five turpentine was administered two hours after the phosphorus, and one died; to the third the antidote was given directly after the poison, and all but one recovered. Roessingh gave a rabbit 25 minims of phosphoretted oil along with 80 minims of olive oil, and to another the same dose of phosphorus along with 80 minims of oil of turpentine. The first died, the latter remained

[1] Bull. de Thérap., lxxvi. 273.
[2] Prager Vierteljahrs., cv. Anal. p. 94.
[3] Virchow's Archiv, liii. 109.
[4] Ibid.
[5] Bull. de Thérap., lxxxi. 313.
[6] Ibid., lxxxii. 459.
[7] Ibid., lxxvi. 353.

quite well.[1] Köhler showed that when phosphorus and oil of turpentine are mixed in the proportion of $\frac{1}{7}$ grain of the former to 15 grains of the latter the animals on which he experimented, dogs and rabbits, are not killed by the phosphorus.[2] The experiments of Vetter also tend to demonstrate the antidotal virtues of oil of turpentine.[3]

It appears that not every oil of turpentine operates as an antidote to phosphorus, but that only which by exposure to the air has absorbed a large proportion of oxygen. According to Köhler such oil forms with phosphorus a compound which he terms terebinthino-phosphorous acid, and which is nearly inert. In this manner phosphorus is prevented from becoming oxidized at the expense of the blood and of the tissues, and thus it averts the disorganization which tends to destroy life.

It is estimated that the longest period at the end of which the antidote will be efficacious is about eleven hours, but much will depend on the dose of the poison, the contents of the stomach, etc. The oil should not be given in emulsion with yolk of egg, which would promote the absorption of the phosphorus, but in capsules containing about ten drops each, every half hour, or still better in the following emulsion: ℞. Oil of turpentine, f℥iij; mucilage, f℥xiv; syrup of orange-peel, f℥ij. S. A tablespoonful every half hour.

Externally.—Oil of turpentine has for a long time been employed as a stimulant, rubefacient, and counter-irritant application, in cases of chronic pain and swelling of a *rheumatic* origin. In these cases it is generally associated with olive oil, or camphor, narcotic extracts, etc., according to the special indications presented. Dr. T. Smith recommends the employment of alkaline turpentine (or camphene) baths in chronic rheumatism, lumbago, sciatica, gout, etc. To prepare them, he directs that one or two pounds of washing soda, with from three to eight ounces of oil of turpentine, be added to a warm water-bath, which is to be repeated every second day.[4] Baths of turpentine vapor for rheumatic affections have been proposed by Chevandier, in consequence of his observing that the workmen in the factories of Die cured themselves of these disorders by undergoing a sweating process in the furnace-chambers where the air is saturated with turpentine vapors, at a temperature of 170° to 180° F. He claims to have been successful in imitating this method. Patients, he says, can readily endure the bath at 140° to 160° F. for twenty or twenty-five minutes. Its effects are those of the hot-air bath, with the addition of a lively itching and sometimes an eruption of the skin.[5] The late Dr. Hartshorne, of Philadelphia, proposed as a powerful stimulant and vesicant a preparation made by boiling together oil of turpentine and powdered

[1] Sydenham Soc. Retros. for 1871–72, p. 440.
[2] Trans. St. Andrew's Med. Grad. Assoc., 1871, p. 54.
[3] Virchow's Archiv, liii. 168.
[4] Braithwaite's Retros. (Am. ed.), xxi. 355.
[5] Arch. Gén., 4ème sér., xxviii. 80.

cantharides,[1] and which has since become officinal under the name of *Linimentum Cantharidis.* It excites pain within half an hour, and vesicates within four hours. It is very apt, however, "to produce troublesome if not dangerous vesication," unless diluted with olive or linseed oil. It was originally employed as a stimulant of the skin of the extremities in the advanced stages of *typhoid diseases*, and also in some cases of *cholera infantum.*

Oil of turpentine, warmed, is a valuable application, as an epithem, in *puerperal peritonitis*, and in cases of simple *flatulent distension* of the abdomen, and in reducing this symptom during the advanced stages of *typhoid fever.*

Burns.—It would appear that oil of turpentine was long a popular remedy for burns among the operatives of Birmingham and Wolverhampton, in England, who were so well acquainted with the benefits attending its early application, that they commonly kept it in their workshops.[2] It was, however, first introduced to professional notice by Kentish, in 1797.[3] He directed the burnt part to be first washed with spirits of turpentine, and then covered with a cloth spread with a mixture of basilicon ointment and oil of turpentine sufficient to reduce it to the consistence of a soft ointment. This dressing was not to be removed for twenty-four hours, and then only for as long a time as might be necessary to apply a fresh one, after washing the part with warm laudanum and spirits of turpentine. The renewal of this application was to be made so long only as was necessary to establish a healthy action of the part, after which mild or astringent dressings were to be employed. Kentish applied his ointment both to superficial burns and to those which had destroyed in a greater or less degree the vitality of the part. Its advantages over the other methods were claimed to be that it cures more rapidly and with less pain; and experience seems to have established its claims to be used, if not as an exclusive method, at all events as one far superior to the sedative and antiphlogistic plan, which sprang from a false theory, and which, in virtue of that power which false theories exert even after their extinction, has continued to influence the medical world to the present time. To the influence of this theory must mainly be attributed the long neglect of the stimulant method of treating burns. In 1831, and again in 1838, Dr. Greenhow called attention anew to its value, insisting particularly on the importance of applying the ointment in such a manner as perfectly to exclude the air throughout the whole course of the treatment.[4] In this precaution, which indeed was not overlooked by Kentish, we may perceive an element of cure which the plan under consideration has in common with that of the raw cotton, flour, and similar dressings.

Prompted by the apparent analogy between *erysipelas* and a superficial *burn*, Dr. Meigs supposed that a remedy which had

[1] Eclectic Repertory, i. 94. [2] Med. and Phys. Journ., v. 236.
[3] An Essay on Burns, in Two Parts, etc., 1797 and 1800.
[4] Lond. Med. Gaz., Oct. 1831, p. 49; and Oct. 1838, p. 82.

proved so serviceable in the latter would also cure the former. He accordingly employed Kentish's ointment (*Linimentum Terebinthinæ*) in erysipelas, with excellent results.[1] Although useful in traumatic erysipelas, there is not sufficient reason for applying it in the idiopathic affection, for which no local treatment is of radical advantage. In *frost-bite*, before inflammatory symptoms occur (chilblain), or after they have been succeeded by a dull livid color and other indications of feeble action in the part, terebinthinate applications are superior to all others. *Gangrene* has been treated with compresses soaked in oil of turpentine, either pure or to which powdered cinchona or oak bark had been added. Dr. Bartholow recommends the application of oil of turpentine to gangrenous sores, by means of a piece of thick cloth saturated with the liquid, and of such a size and shape as not to overlie the edges of the sore or wound. He holds that it produces a solution and discharge of the gangrenous tissue.[2] This method has also been successfully employed in Europe. Thielmann states that he used this remedy with great success in 342 cases of *carbuncle*, during a period of eight years. He employed a mixture composed of an ounce of oil of turpentine and one of tincture of camphor, the yelk of an egg, and a pint of chamomile tea. This he applied in every stage of the disease, upon a thick pad of charpie, which was then covered with oiled silk. This dressing excites a slight sense of burning, which, however, quickly subsides: "the epidermis softens, and the slough separates without the necessity of the crucial incision."[3] Kerner states that he has found the following a most valuable as well as cheap application for all kinds of *wounds:* Venice turpentine, 2 lbs. 8 oz. troy; bicarbonate of soda, 6½ drachms; water, 18 pints. Digest in a bath for six days, at a temperature not higher than 175° F., and then filter. It quickens granulation in a remarkable manner, preventing fetor, rendering the secretion of pus very slight, and cicatrization wonderfully rapid.[4] When *deafness* depends upon dryness of the auditory canal and a deficient secretion of cerumen, a drop or two of this oil, mixed with an equal quantity of almond or olive oil, will sometimes restore the function of the part. Dr. Geddings, of Charleston, speaks highly of the efficacy of oil of turpentine as a remedy for the *sore mouth* produced by *mercury*.[5] For this purpose it may be applied pure to the ulcerated surface by means of a camel's hair brush, or an emulsion containing it may be used as a wash or gargle.

Administration.—The dose of oil of turpentine as a stimulant is from five to twenty or thirty drops three or four times a day, and as an anthelmintic from two to four fluidrachms every half hour until two, three, or four doses are given. It may be prescribed in emulsion with yelk of egg, gum, and sugar, and some aromatic

[1] N. Am. Med. and Surg. Journ., vi. 76.
[2] Cincinnati Lancet, etc., Oct. 1864.
[3] Times and Gaz., Sept. 1855, p. 325.
[4] Med. Press, Sept. 1865, p. 274.
[5] Am. Journ. of the Med. Sci., vii. 266.

water as a vehicle. The addition of a few drops of creasote, cajeput oil, or tincture of capsicum, tends to prevent nausea, and from ten to twenty drops of oil of rosemary render it less disagreeable. A liniment of turpentine with acetic acid will be found a useful rubefacient. It is made by mixing equal weights of oil of turpentine, acetic acid, and liniment of camphor.

CREASOTUM.—Creasote.

Description.—Creasote (κρέας, flesh, and σώζω, I preserve) was discovered by Reichenbach, of Blankso, in 1832. It is procured by the dry distillation of various vegetable as well as animal substances, but is officinally described as a peculiar substance obtained from wood-tar. It is a colorless, oily liquid, of a peculiar, disagreeable, and penetrating odor, resembling that of wood-smoke, and has a burning, acrid taste, which is perceived throughout the whole extent of the buccal, nasal, and pharyngeal mucous membrane. Its specific gravity is 1.046. It boils at 397° F., and is not frozen at —17° F. It burns briskly in the air, emitting large volumes of smoke. Creasote coagulates albumen, but exerts no action upon fibrin. It is soluble in alcohol, ether, the volatile and fixed oils, acetic acid, and alkaline solutions, and acts as a solvent of iodine, phosphorus, sulphur, and the resins. With water it forms two solutions, the one containing one part of creasote. To this peculiarity is due its property of preserving flesh from decomposition; and its entering into the composition of smoke and wood vinegar renders them antiseptic. "It is distinguished from carbolic acid, which it in some respects closely resembles, by not coagulating collodion when mixed with it, and by not imparting a blue color to a slip of pine wood dipped first into an alkaline solution of creasote, and then, after drying, into muriatic acid." U. S. P.

Action. *On Plants.*—Miguet[1] states that plants die when they are watered with a solution of creasote. A young and vigorous rose-bush, in full bloom, when thus treated, withered in the course of eight days. A few drops of the same solution, applied to a red rose, deprived it both of color and life.

On Animals.—Small *fish* die speedily in two ounces of water containing twelve drops of creasote. *Flies*, *wasps*, *spiders*, and other insects, show signs of great uneasiness at the contact of creasote water, and at length die in spasms.

This substance acts as an energetic poison upon *dogs*. Miguet gave daily, to a dog two months old, eight drops of diluted creasote. Its depressing effects were visible in the slow and painful gait of the animal, and the occurrence of frequent nausea, with tremulousness and emaciation. Cormack found that when given to dogs, in doses of thirty drops, it produced salivation, vertigo,

[1] Chemical and Medical Researches on Creasote. Translated by W. Wetherill, M.D. Philadelphia, 1835.

muscular twitching, and insensibility. The same dose, administered to a *rabbit*, occasioned violent convulsions and speedy death.[1] In Miguet's experiments a dose of two drachms, administered to a young dog, gave rise to signs of distress, a fixed look, vertigo, dulness, and indifference. The respiration was labored, whining, and irregular; a secretion of mucus appeared to obstruct the air-tubes and hung from the mouth; eructation and violent retching ensued. At the expiration of two hours the breathing became extremely laborious and interrupted by long intervals, the limbs were tremulous and jerking, and death speedily ensued. The principal lesion discovered was universal vascular injection of the gastro-intestinal mucous membrane. The lungs were gorged with blood, and in the heart and great vessels this fluid was more firmly coagulated than usual.

The effects were much more rapid and serious when creasote was injected into the bloodvessels. When a drachm of the liquid was thrown into a vein, the heart abruptly ceased to beat. Thirty drops, used in a like manner, produced convulsions and death. In the arterial circulation the effects were less prompt and fatal. The breathing became labored and hurried, and there was vertigo followed by stupor. These phenomena appeared to depend in a great degree upon the remarkable property possessed by creasote of coagulating the blood. A drachm and a half of the liquid was injected into the carotid artery of a dog. In half an hour the animal became drowsy and was convulsed, but at length recovered. In another experiment twelve drops of creasote were injected in a like manner. The animal uttered a sharp cry, during a few seconds breathed low and hard, and then appeared to become insensible. He, however, did not die. In neither of these cases did hemorrhage take place from the artery, although no ligature had been applied. This circumstance is not to be attributed altogether to the styptic power of the creasote employed, since it has been proved by numerous experiments that the coagulability of the blood in the lower animals is vastly greater than in man, a fact which explains the apparent success of various styptic nostrums when tested by experiments similar to those here related. Köhler, of Warsaw, performed an experiment upon himself in order to test the styptic property of creasote. Having made in his own arm an incision an inch in length by three or four lines in depth, he applied creasote water to it freely, but produced no other effect than a painful smarting. A drop of pure creasote was then introduced between the lips of the wound, which became very painful, and its surface was covered with grayish-white flocculi. The flow of blood stopped, then broke out afresh, but soon afterwards ceased permanently. The wound remained painful and inflamed, but healed without further accident.[2]

On Man.—The experiment just described represents the action of

[1] A Treatise, etc. on Creasote. By J. Rose Cormack. Edinburgh, 1836.
[2] Strumpf, Handbuch, i. 903.

creasote in part. More generally, when applied pure to a mucous membrane, or to the denuded cutis, it acts as a powerful irritant and even as a caustic, exciting a burning pain, covering the surface of parts devoid of epidermis with a whitish film formed of coagulated albumen, and even producing ulceration. Wherever the skin is naturally delicate, or is rendered susceptible by disease, this application is very severe. Upon the conjunctiva it becomes intolerable, and when applied to the tongue it occasions, as already stated, a powerful burning sensation. The taste is so penetrating and peculiar that it can readily be detected in a solution of one part of creasote in ten thousand of water.

When creasote is swallowed in large quantity, it occasions severe and even alarming symptoms. There appears to be only one case of its fatal poisonous effects on record, and in that the quantity of creasote swallowed was two drachms Death took place in thirty-six hours.[1] Strumpf speaks of a woman sixty years of age who took "a considerable quantity" of creasote by mistake. She was immediately attacked by severe colicky pains, and within three hours had upwards of forty very painful and bloody stools. She recovered under the use of oil, milk, and opium. In smaller, or medicinal doses, it has, according to Headland, "a double action, being anodyne like hydrocyanic acid, and a mucous stimulant like turpentine." In doses of from one to two drops it produces a slight and temporary burning in the fauces and œsophagus. When large doses have been continued for some time, they are apt to occasion dulness, giddiness, fainting, and some excitement of the circulation, with difficulty of breathing, nausea or retching, muscular lassitude, yawning, and constipation. The urine is generally augmented in quantity, but in diabetes is said to be diminished under the influence of creasote. This secretion is often darkened by it, as if it were colored by Indian ink, and exhales the odor of the medicine. Sometimes, also, it occasions micturition and even strangury. The quantity required to produce these toxical effects varies extremely. In some instances a single drop seems to have been sufficient, and in others as much as forty or even eighty drops have occasioned no bad consequences. Such discordant effects are scarcely explicable unless upon the supposition that the medicine employed was of various degrees of strength, or that its powers are neutralized by habit, or else that the stomach contained food in some cases, and not in others. The vapor of creasote, when inhaled, is said to occasion stupor. Corneliani relates the case of a woman who was attacked with faintness, trembling, efforts at vomiting, palpitation of the heart, etc., in consequence of the continued application of creasote water to a large ulcer of the leg.[2]

Remedial Employment. *Vomiting.*—Creasote was first employed to counteract this symptom, as it occurred in cholera, by

[1] London Times, June 17th, 1839.
[2] Br. and For. Med. Rev., i. 265.

Dr. Elliotson,[1] who states that his discovery of its anti-emetic property "was not the result of reasoning," but of experiment. He subsequently made use of it in other forms of vomiting independent of gastric inflammation, and found that no medicine was at all comparable to it in allaying this symptom. He knew it to succeed where hydrocyanic acid had failed, and especially in nervous vomiting, the vomiting of pregnancy, in cases of obstructed bowels, and even in those of arsenical poisoning. He usually began with a dose of one or two drops, and if this was rejected, it was immediately renewed. Weber confirms this statement of its efficacy so far as the vomiting in cholera is concerned. He gave one or two drops every two hours with mucilage of salep or gum Arabic.[2] Dr. Burne found it peculiarly useful in relieving the morning sickness of intemperate persons.[3] According to Dr. Neligan, in the obstinate vomiting of sea-sickness, this medicine has been found useful by some, and in many nostrums of the present day for preventing sea-sickness, creasote is a principal ingredient. To allay the inordinate thirst and excessive craving for food in diabetes, creasote is one of the most certain medicines that can be employed.[4] According to Rayer, it palliates the obstinate vomiting so frequently met with in Bright's disease. In chronic affections, and even in malignant ulceration of the stomach, McLeod found it very useful, although less efficient than hydrocyanic acid.[5]

Hemorrhages.—The first employment of creasote as a hæmostatic was in external hemorrhages. Miguet had already, in 1835, shown its power of arresting the flow from a bleeding surface. His statement has been confirmed by numerous observers. Burdach applied it with perfect success in hemorrhage from a gangrenous ulcer;[6] Thomson, in bleeding from a cancerous ulcer of the os uteri, mixed with a solution of gum tragacanth, and applied to the part upon a sponge;[7] Daser, in hemorrhage after the operation of lithotomy;[8] and many other examples to the same effect might be cited. Its influence upon internal hemorrhages seems to be quite as great, if not still more decided. Dr. Allnatt used it successfully to arrest the bleeding of internal piles. Dr. Wragg, of Charleston, has reported fourteen cases, including hemorrhage from the lungs, bowels, bladder, and uterus, in which it was given internally, and which appear to demonstrate its hæmostatic virtues.[9] Arendt found it very useful in menorrhagia in non-pregnant women, and in some cases of unavoidable hemorrhage due to placenta prævia.[10]

Fevers.—On the ground, probably, of a theoretical notion of the similarity between the morbid processes involved in idiopathic *fevers* and those concerned in putrefaction, creasote, like other

[1] Med.-Chir. Trans., xix. 217.
[2] Bull. de Thér., xlvi. 184.
[3] London Medical Gazette, xxii. 805.
[4] Medicines and their Uses, 4th ed., p. 336.
[5] Lond. Med. Gaz., xvi. 598.
[6] Month. Journ. of Med. Sci., ii. 469.
[7] Times and Gazette, Aug. 1854, p. 213.
[8] Edinb. Med. and Surg. Journ., Oct. 1841.
[9] Charleston Journ., i. 121.
[10] Brit. and For. Med.-Chir. Rev., xii. 558.

antiseptics, has found witnesses in favor of its virtues in these affections. But, as usual, clinical experience has disproved their conclusions, and shown them to be drawn from hasty and partial observations made under the influence of a theory whose chief recommendation, in its authors' eyes, was its harmony with their own speculations.

Chronic Pulmonary Affections.—When first introduced, creasote was reputed to be curative of pulmonary consumption, but a more extended observation of its effects proved that it had no influence beyond producing a diminution of the bronchial secretion, and, in so far, a mitigation of the cough. In *bronchorrhœa*, however, and in the chronic catarrhs of old persons and those of a loose phlegmatic habit, the remedy proves useful both when given by the stomach and when inhaled. It is, nevertheless, less efficient and less easily tolerated than other terebinthinate medicines, and especially copaiba.

In *diabetes mellitus* creasote has been recommended by Berndt, and it does indeed appear to moderate in some degree the urinary discharge; but this effect is more unequivocally manifested in simple diuresis, or polyuria. Like the oil of turpentine, creasote possesses *anthelmintic* properties, and has been successfully employed for the expulsion of tæniæ, lumbrici, and other intestinal worms, but it possesses no evident superiority over the medicine named, if indeed it is equally efficient. It has been recommended by Budd in gastric fermentation productive of *sarcinæ;* but Küchenmeister says that it is of no value. Dr. Elliotson reports several cases of *neuralgia* affecting the spinal or facial nerves, in which it appeared to effect a cure after other remedies had failed.[1] The success obtained by Reich in *gouty and rheumatic* disorders with a tincture of soot prepared in a peculiar manner, induced him to try the internal use of creasote in these affections. He made the first trial upon himself, for the relief of a terebrating pain, with numbness and partial insensibility of the right leg, produced by cold. The attack, which seems to have resembled *sciatica*, resisted all the treatment employed until he began the use of creasote, which in nine days brought it to a termination. Another case of rheumatism affecting several of the larger jonts, and occurring in a lady, was cured by the same means. Marcus also recommended the medicine in atonic forms of rheumatic disease.[2] In fact, all the varieties of this affection which are free from decided inflammatory action, are probably benefited by creasote, as they are still more by the oil of turpentine.

Toothache.—When this complaint depends upon inflammation of the nervous pulp itself, the application of pure creasote generally mitigates or quite relieves the pain. Reichenbach first suggested the use of a mouth-wash of creasote water; but Saunders[3] afterwards recommended that, when the nerve is exposed, a small piece

[1] Med.-Chir. Trans., xix. 222. [2] Riecke, Die neuern Arzneimittel., p. 256.
[3] Lond. Med. Gaz., xxii. 170.

of cotton wet with creasote should be introduced into the carious cavity, but not in such a manner as to exert much pressure. Care should also be taken to protect the gums, cheek, and tongue from the corrosive action of the liquid. This effect may be obviated by using a mixture of fifteen parts of creasote to ten parts of collodion. It was at first supposed that the creasote exerted an antiseptic influence, preventing the extension of the existing caries; but this impression was probably erroneous. In cases of rheumatic odontalgia a mouth-wash containing creasote alleviates the pain. The same preparation is also useful to correct fetor of the breath.

Leucorrhœa.—In many cases of the chronic form of this affection injections of creasote water have been found successful after the failure of other remedies. Schmalz, Most,[1] and Allnatt[2] bestow great commendation upon this plan of treatment. The last-named writer used the following formula for an injection: ℞.—Creasoti, liq. potass., āā f℥j; sacch. alb. gr. cxx. Mix in a mortar, and add by degrees mist. camphor f℥vj. It is advised to use in the above mixture at first only ten minims of creasote. In *gleets*, Arendt found three or four injections of a mixture containing two or three drops of creasote to an ounce of mucilage sufficient to effect a cure.

In *deafness* depending upon a scanty secretion of cerumen, Curtis found this medicine to act as a useful stimulant, and restore the impaired function. If the auditory canal is obstructed, it must first be cleansed with soap and water, after which its internal surface should be touched night and morning with a mixture of one part of creasote to four parts of almond oil.[3] *Burns* have been advantageously treated by means of lotions of creasote water, with compresses wet with this liquid, or with creasote ointment, as they have with the terebinthinate preparations described in another place. The same applications are often useful in *chilblains*, and also in *erysipelas*. In atonic, indolent, and varicose *ulcers* this remedy, of various degrees of strength, and in the several forms above mentioned, has been found to act as a wholesome stimulant by Reichenbach, Heyfelder, Berthelot,[4] Fife,[5] and others. It is peculiarly applicable to such as have flabby, fungous granulations, an ichorous discharge, a tendency to gangrene, or a connection with caries of the subjacent bones. In *cancerous ulcers* creasote has been found useful, for the purpose of correcting their fetor, and sustaining the tissues against the progress of the destructive ulceration. Its antiseptic virtue has also been employed to correct the *fetor* of certain discharges. Thus, Haybach recommended that in *gangrene of the mouth* the affected part should be touched with creasote on a fine camel's hair brush.[6] Elliotson used the pure preparation in *mercurial stomatitis;* and injected a solution of it into the nostrils, with equal success, in a case of *chronic glanders* affecting the nostrils and frontal sinuses, with pain and a fetid discharge. The antiseptic qualities of creasote also render it useful as a means

[1] Riecke, op. cit.
[2] Lond. Med. Gaz., xxv. 847.
[3] Lancet, 1838–39, i. 328.
[4] Riecke, op. cit.
[5] Lond. Med. Gaz., xxii. 63.
[6] Bull. de Thérap., xlvi. 44.

of correcting the fetor and counteracting the tendency to putrefaction of bodies used for anatomical purposes. With the latter object it has been injected into the bloodvessels. It is best adapted for the preservation of the nervous centres.

Cutaneous Eruptions.—Many diseases of the skin have been successfully treated by the use of lotions or ointments of creasote. A large number of authorities testify to its efficacy in the cure of *scabies*, but it does not appear to have any advantage over other methods which are less expensive and at the same time less uncertain in their effects. It sometimes acts very favorably in allaying the intense itching of *prurigo*, and more decidedly even in cases of chronic *eczema*. Masse, considering that creasote checked fermentation by preventing the growth of the spores of the vegetable cryptogams in the fermenting liquid, conceived that it might also destroy the microsporon on which the development of *sycosis* depends. He found, on trial, that this parasitic affection was cured by a lotion containing one part of creasote to fifty parts each of alcohol and water. According to this authority, creasote does not immediately destroy the cryptogam of which the mycelium is already developed, but it renders the spores incapable of germinating.[1] Martin-Solon reported the cure of a case of general *ichthyosis* by its use, and statements are not wanting of its favorable influence as a local application in *lupus* and also in the *Greek elephantiasis*. In spite of these and other examples of its utility, the remedy has not been generally adopted into the list of medicines which are most approved by physicians devoted to the treatment of skin diseases.

Warts, etc.—Rainey found pure creasote an efficient remedy for these excrescences, when they were thoroughly moistened with it and then covered for two days with a strip of adhesive plaster. The application rendered them soft and friable, and so easily broken down by friction that after several applications of it they were quite eradicated.[2] It has also been used in a similar manner for the cure of *corns*, by Vetter, of Berlin. Reichenbach found it a successful application to *condylomata*. Thorsten employed it with good results for the removal of *nævi materni*. He applied it to the tumor in a lotion of variable strength, on compresses, and several times a day. Its first effect was to produce excoriation; ulceration followed, and the tumor shrank and disappeared, leaving a smooth cicatrix behind it.

The smell of creasote is best removed from the fingers by washing them with chlorinated water. Its poisonous effects may be combated by stimulants, such as wine, coffee, ether and its preparations.

Administration.—Creasote may be given in pill or in emulsion; the former mode is the less eligible of the two. It is said to be most readily miscible with water by means of an equal quantity of liquor potassæ; to this some aromatic water or tincture and a little syrup may be added, to disguise the taste. The same object is in a

[1] Braithwaite's Retros. (Am. ed.) li. 190. [2] Lancet, Dec. 1856, p. 545.

measure fulfilled by the creasote mixture of the British Pharmacopœia, viz.: Creasote and acetic acid, of each ♏xvj; spirit of juniper, f℥ss; syrup, f℥j; water, f℥xv. Mix the creasote with the acid, add gradually the water, and lastly the syrup and spirit. Each fluidounce contains ♏j of creasote. The *dose* of creasote is one or two drops repeated at intervals of one or two hours, or only two or three times a day, according to the exigencies of the case. It may be gradually increased to nine or ten drops. Sometimes a single drop disagrees with the stomach, while in other cases forty and even ninety drops a day have been taken with impunity.

ACIDUM CARBOLICUM.—Carbolic Acid.

Description.—This acid, which is also known as *phenic acid*, and by various other names, received its more common title from Runge, who in 1834 discovered it in coal tar. It is procured from this substance by distillation at a high temperature (300° to 400° F.). If allowed to condense at a temperature below 95°, it forms long, white, acicular crystals. On exposure to the air, they attract moisture and deliquesce. As generally sold, carbolic acid is an oily colorless liquid, smelling very strongly, and in some degree like creasote, which it also resembles by its pungent acrid taste. Its sp. gr. is 1.065. It is sparingly soluble in water, but is freely dissolved by glycerine, oil, alcohol, ether, and strong acetic acid. With alkalies it forms acid salts, and combines with metals, with iodine and bromine, and with quinia, alcohol, etc. This acid bleaches iodine.

History.—Before carbolic acid was employed separately, its virtues were exhibited in the crude material known as *coal tar*, which was employed as early as 1844 by M. Bayard, in 1859 in an emulsion with saponine by M. Le Boeuf, and by MM. Corne and Demeaux, in the form of a powder made by mixing it with lime. It was first used as a surgical disinfectant in Paris, and afterwards during the campaign for the conquest of the Austrian provinces in Italy. The coarse composition and dirty appearance of the mixture, and its offensive odor diminished its vogue, when it was for a time (1860) succeeded by an emulsion of coal tar with saponine, which obviated most of the objections made to the original preparation. About the same time Küchenmeister made use of carbolic acid, under the name of "spirol," with the most satisfactory results both in medical and surgical practice, and as a means of arresting putrefaction, and preventing the development of fungi. In 1863, Dr. Lemaire, of Paris, who had previously (1860) published an article on the subject, issued a complete treatise upon phenic acid, in which he illustrated its power of preventing fermentation and putrefaction, and pointed out its application to a variety of medical and surgical uses. Two years later M. Déclat added to the information upon the subject, by illustrating the power of the acid to destroy the microphytes and microzoaires, which are developed during the processes just referred to, and of preventing the changes which constitute these

processes. After these last two publications carbolic acid was generally used in Europe and in this country. Its vogue is chiefly to be ascribed to the enthusiastic eulogies of Professor Lister, who commenced its employment as a surgical dressing in 1865, and two years later published accounts of its power to prevent suppuration in compound fractures and other wounds, which were supposed to introduce a new era in the treatment of surgical injuries.[1]

Action. *On Vegetable Organisms.*—All the lower forms of vegetable organic life are destroyed by carbolic acid. It arrests fermentation, destroys mould and mildew, and prevents the germination of seeds, in water containing a hundredth, or even a two hundredth part of this acid. A strong solution of it applied to the roots of shrubs and trees kills them; and if to the flowers, leaves, and fruits, these die.

On Animal Organisms.—An exceedingly minute proportion of carbolic acid in water containing bacteria, amœbæ, and similar minute creatures, speedily destroys them. It is equally hostile to the life of ascarides, earthworms, caterpillars, fleas, moths, ants, and other insects. Fish, frogs, and leeches speedily die in a solution of 5 per cent. strength; and two or three drops applied under the wing of a sparrow produce convulsions and death. The virtues which one might be tempted by these experiments to ascribe especially to carbolic acid are exhibited by various other substances, among which alcohol is quite as potent in destroying the life of spermatozoa and animalculæ.

To animals of the articulate class an atmosphere of carbolic acid is speedily fatal; it destroys the common earthworm in a minute. Fish, frogs, and leeches die slowly in a saturated aqueous solution. In the case of frogs the first effect noticed is paralysis of the anterior extremities, then of the other parts, and finally of the heart. When a 5 per cent. aqueous solution of carbolic acid is administered to dogs, they fall, cough, and are convulsed, and then paralyzed in sensation as well as motion; the acid is exhaled in breathing, and they gradually recover. Half a fluidrachm of carbolic acid dissolved in about twelve fluidrachms of glycerine was thrown into the stomach of a dog; the above-mentioned symptoms were presented, besides which bloody froth was rejected. The dog died suddenly ten minutes after the administration of the acid. It has been found that all albuminous substances lessen the action of the acid upon the animal economy. After the death of animals from poisonous doses of this substance, extreme congestion is found of the brain and its membranes, of the alimentary canal, and of the lungs. The blood is not coagulated.

The *local* action of the acid is illustrated by the experiment of Neumann, who applied a solution of it (1:4 alcohol) to a dog's ear. A circumscribed swelling formed and was followed by an eschar; and the parts on subsequent examination showed that the acid had

[1] Lancet, March, 1867, p. 326.

penetrated the tissues, rendering them transparent, and mummifying, but not destroying their elements.[1]

On Man.—According to Dr. Bill[2] when six or eight grains of carbolic acid are taken in a wineglassful of water, a sense of numbness is felt on the lips and in the mouth, followed by a sensation of coolness. Then, if the stomach is empty, slight nausea and an uneasy sensation in the abdomen follow, with vertigo, ringing in the ears, and slight deafness. The pulse falls in frequency and force, as does also the cardiac impulse, and diarrhœa sometimes occurs. If the acid is continued this state of debility persists, with some loss of flesh. According to Lemaire and others, carbolic acid is largely exhaled by the lungs; but Dr. Bill affirms that this is an error, and that he has been unable to detect it in the expired breath. Waldenström has called attention to the irritation of the urinary passages which carbolic acid sometimes occasions even when it is applied externally. He describes the urine passed under these circumstances as being very dark, acid, and turbid, possessing a peculiar smell, and containing a small quantity of albumen. On the addition of sulphuric acid and distillation of the urine, carbolic acid was obtained. Almen asserts that the dark color and tar-like odor of the urine which have been just referred to, are not observed after the internal use of the medicine.[3] Dr. Bill also states that after the ingestion of even thirty or forty grains of carbolic acid in twenty-four hours the urine is natural in color and odor, and contains no albumen; but if such urine is reduced one-third by gentle evaporation, a brownish discoloration takes place in it, which subsequently forms a blackish precipitate, and which, from its containing a certain amount of iron and phosphates, he concluded to be hæmatin combined with carbolic acid. This substance, according to Dr. B., is to be distinguished from that which may be found in the urine after either the internal or external use of carbolic acid, and which is formed, not immediately, but only after the urea of the urine has begun to be converted into carbonate of ammonia. In the course of three weeks it gives to all the urine a black-brown color, and is regarded by Dr. B. as being changed carbolic acid.[4] Whatever view may be taken of the nature of the discoloration observed in the urine, no doubt can exist of its being an effect of the absorption of carbolic acid. This effect may even occur in the nursing child when the mother is using the acid. Mr. Macnamara dressed an abscess of the axilla, which he had opened, with a poultice containing this substance, and a few hours afterwards the infant became affected with a copious diuresis, and its cloths were covered with stains of a deep inky color.[5]

As a Poison. Internally.—The poisonous effects of carbolic acid are remarkably uniform for the same dose. When taken by an

[1] Ranking's Abs., xlvi. 116.
[2] Am. Journ. of Med. Sci., July, 1872, p. 45.
[3] Boston Med. and Surg. Journ., Dec. 1870, p. 397.
[4] Op. sup. cit., p. 47.
[5] Practitioner, vi. 72.

adult in the dose of an ounce or more, an intense burning pain is felt in the throat and œsophagus, followed by staggering as if from intoxication, and then by complete insensibility. The face is pale; the lips and hands livid; the pupils usually contracted, though in rapid death they may be dilated; the pulse is generally above the normal rate of frequency, but sometimes much below it, and at the same time soft and compressible; the respiration is stertorous, and mucous and sonorous rhonchi fill the lungs; the tongue is swollen, and a discolored foam sometimes stains the lips. The skin, breath, urine, and fæces, if any, smell strongly of the acid; the urine is sometimes passed with difficulty, occasionally is suppressed, but is often copious. Discharges from the bowels are uncommon. Death takes place in from one to three hours in most of the cases in which an ounce or more of the acid has been swallowed. But there are cases in which this event is almost instantaneous, as in the case reported by Dr. W. E. Taylor,[1] of a sailor who drank from a bottle of carbolic acid which he replaced upon the shelf whence he had taken it, and immediately fell, and died in three minutes. A very analogous case is related by Mr. Barlow, in which death was almost instantaneous.[2] In a third case death within an hour followed the ingestion of an ounce and a half of the acid.[3] The *lesions* found after death are summarily these: The skin is often purplish in dependent parts; about the angles of the mouth it is apt to be discolored and shrivelled by the caustic action of the acid, which also renders the mucous membrane of the mouth very white; the tongue is dry; the œsophagus dry, brown, and shrunken, and its epithelium is readily detached; the mucous membrane of the stomach is more or less reddened, especially along the edges of its rugæ, sometimes it presents whitish patches, and is easily peeled off; its epithelial layer is sometimes cornified. In the duodenum slighter evidences of similar alterations are occasionally met with. The kidneys present no special lesions. The larynx, trachea, and bronchia are generally filled with bloody and frothy mucus, and the lungs are congested, in cases that have survived for some hours the taking of the poison. The heart, in like manner, presents different appearances, being sometimes empty and sometimes gorged with dark blood, which is generally liquid. The brain is darkly congested in most cases, and in some is bathed with a serous effusion.[4]

Externally.—The application of carbolic acid to the surface of the body in the treatment of wounds, ulcers, diseases of the skin, etc., is frequently followed by giddiness and vomiting, and the discharge of characteristically dark urine. Sometimes the application has been fatal. Three women used crude carbolic acid in mistake for

[1] Phila. Med. Times, ii. 284. [2] Lancet, Sept. 1869, p. 404.
[3] Ibid., Mar. 1869, p. 395.
[4] Compare Lancet, July, 1868, p. 133; Jan. 1869, p. 179; Mar. 1869, p. 395; Sept. 1869, p. 404. Times and Gaz., Ap. 1868, p. 456; Oct. 1870, p. 474; April 1871, p. 423; British Med. Journ., Feb. 1871; Guy's Hosp. Rep. 3d. ser. xiii. 233; Boston Med. and Surg. Journ. Jan. 1870, p. 72; Liverpool Med. and Surg. Reports, v. 110; Glasgow Med. Journ. v. 266.

sulphur ointment in the treatment of itch, applying it all over the body with a sponge. They soon experienced a smarting pain, then headache, and giddiness, and became insensible. One died in five hours. A second remained insensible for the same length of time, then tried to vomit, the respiration being rapid and irregular. She died in two days from congestion of the lungs. The third patient, an old woman, remained four hours insensible, then complained of a sense of constriction in the head and violent burning of the skin. She did not vomit, and her pulse was 80. A branny desquamation of the cuticle followed, and in three weeks she was well.[1] A man of 80 had an eczema treated with one part of carbolic acid to four of lard, which was spread upon his arms and thighs and covered with oiled silk. An hour and a half later he was reported to be dying, and was found unconscious and comatose, with contracted pupils, a weak and quick pulse, cold feet, lividity of the skin, and bronchial râles. Stimulants were given; free vomiting followed of matters smelling strongly of carbolic acid; consciousness returned, and the eruption got well.[2] Two cases are reported in which the application of carbolic acid was followed by unconsciousness, suppression of urine, and death.[3] In another case, a female child sat down upon a block of wood which had been sprinkled with a solution of an ounce of carbolic acid in a quart of water. Blistering, followed by ulceration of the buttocks and labia, took place, and the child died on the tenth day.[4] The foregoing cases, which might be matched by many others, show that carbolic acid, both internally and externally, may become a mortal poison, and that, therefore, great circumspection in employing it should be observed.

In cases of poisoning by carbolic acid the stomach should be emptied as soon as possible by means of warm water, and afterwards albumen, in the form of fresh eggs largely diluted with cold water or with milk, should be freely administered. Enemata containing whiskey or other alcoholic liquid have also been found beneficial in the stage of collapse.

Local Action.—If strong carbolic acid be applied to the surface of the skin, an immediate tingling and burning sensation is experienced; the spot affected becomes white, the neighboring skin displays a red areola, and the symptoms are similar to those attending the application of a powerful caustic. In the course of a few days there is exudation from the surface attacked by the carbolic acid; sometimes this is dry and scaly, but frequently there is some formation of pus. The irritation persists for a fortnight or three weeks, but after the first few hours the pain is inconsiderable (*Sansom*). A more superficial application of the acid is found to diminish the sensibility of the skin so much that incisions into the part, and even the application of caustic potassa, give but little pain.

[1] Brit. Med. Journ., Mar. 1868, p. 220.
[2] Boston Med. and Surg. Journ., Oct. 1870, p. 257.
[3] Practitioner, iii. 324.
[4] Brit. Med. Journ., Oct. 1870, p. 382.

Action in Arresting Fermentation and Putrefaction.—It is to this property that the utility of carbolic acid in medicine is chiefly due. A very small proportion of the acid added to a solution of sugar with yeast, and placed under the most favorable conditions for fermentation, will completely prevent this process, or arrest it if it has already commenced. All forms of animal tissue are protected indefinitely from putrefaction by this acid, which arrests it also after it has begun. It forms the best antidote to the stings and bites of insects; yet it does not, when mixed with the venom of snakes, prevent its poisonous action, but only delays it. It is commonly used as a deodorizer; but it has no action upon foul emanations. Its operation consists in preventing their generation by arresting putrefactive changes in the substances which exhale them. In what manner it does so is undetermined.

Lemaire, in common with many others, held that they are due to septic infusoria in the atmosphere; which "when admitted into wounds, ulcers, etc., produce a decomposition in the part and its secreted fluids, aiding the formation of pus; that this decomposition is effected by a vital action similar to the production and multiplication of organisms in the process of fermentation; and that carbolic acid, even in very small doses, has the power of preventing and arresting any such decomposing effects from these organisms by at once and immediately destroying the life of the organisms themselves."[1] Dr. James Watson found that the addition of carbolic acid to diabetic urine prevented the development of the sugar fungus in that liquid.[2] Like Lemaire, Mr. Lister adopted the theory of Pasteur in regard to the cause of decomposition in the fluids of the body, and considered the utility of carbolic acid to depend upon its power of killing the septic germs.[3] Whether this view be correct or not, our judgment cannot alter the facts which demonstrate the efficacy of the acid in disinfecting substances already in a state of decomposition, and of preventing injured parts from undergoing this transformation.

Uses. *As a Disinfectant.*—The earliest use of *coal tar* proved that it immediately destroyed the fetor of *putrid substances*, of *gangrenous* and *suppurating wounds*, of foul ulcers both simple and cancerous, and of the offensive discharges from such parts, and that it, at the same time, prevented them from being frequented by flies and infested with maggots. In like manner it was used to neutralize the odor of *dissecting rooms*, *close stools*, *sewers*, *drains*, *privies*, etc. For all such purposes *carbolic acid* proved to be much more efficient, and much less disagreeable. Dr. Déclat was, we believe, the first to employ it as a dressing for *gangrenous wounds*, and Maisonneuve made use of it habitually in his hospital wards, with the effect of rendering the air entirely devoid of unpleasant smell. Similar results were obtained by Calvert, Hughes, Watson, and Lister, in England, and by many others in this country and elsewhere; yet

[1] Lancet, Nov. 1867, p. 547.
[2] Edinb. Med. Journ., ix. 626.
[3] Lancet, March, 1867, p. 327.

not a few found that it less completely corrected, than coal tar, the foul odors of gangrenous parts, probably because its sustained operation is more difficult to secure. To do so lint or some other porous substance saturated with carbolic acid dissolved in olive oil should be kept applied to the part.

The use of carbolic acid in the treatment of *surgical wounds*, including those made by the knife, by compound fracture, etc., and the discussions to which it gave rise in Great Britain, have done more than anything else to keep this agent prominently before the medical profession. With this discussion Mr. Lister was inseparably connected, as well because he was the first successfully to call the attention of his countrymen to the subject, as because his claims to originality were disallowed, and because he very unnecessarily imitated his continental predecessors, in not only claiming for the new remedy a superior power of preventing suppuration, pyæmia, and the other accidents of wounds, but also by adopting in explanation of his alleged successes, a theory which attributed to carbolic acid a power of neutralizing or destroying the "septic germs," upon whose influence the accidents in question were supposed to depend. The hypothesis and the practice being thus intimately associated, each was defended and assailed through the other, and both attracted partisans whose zealous conflict kept alive the subject in Great Britain long after it had ceased to inspire a special interest in other countries. Even Mr. Lister himself appears to have subordinated the palpable influences of carbolic acid applied to fresh or even granulating surfaces to his purely hypothetical idea of excluding from them septic organisms floating in the atmosphere, and even to have admitted that his object might equally well have been gained by employing "on the same principle" some familiar disinfectant.[1] The late Sir J. Y. Simpson conclusively proved that in the treatment of compound fractures, suppurations, and wounds, carbolic acid had been used by continental surgeons before Mr. Lister employed it, and upon the very principle at first maintained by him, that it kills living ferments. And, admitting that it prevents in a great degree suppuration, and the accidents which attend the prolonged exposure of suppurating surfaces to the air, Simpson claimed that an equal benefit, and of the same nature, is to be derived from acupressure, which also tends to maintain the surfaces of wounds in apposition. The same line of argument was taken up by Mr. Nunneley, who has shown that from the very earliest history of surgery means were employed to exclude the atmospheric air from wounds, and to limit their suppuration by substances of the same nature as carbolic acid, coagulating the exudation, or hindering its discharge, or which coated the injured surface, and so protected it. Many of these substances are still known as *balsams*; and although they are at present more used in popular than in professional surgery, they are not on that account less valuable.[2] Indeed, it is a well recognized rule not to close a wound until it

[1] Lancet, Oct. 1867, p. 502. [2] Times and Gaz., Aug. 1869, p. 161 *et seq.*

has ceased to bleed, because the blood will hold its opposing surfaces apart; while, on the other hand, the exudation of liquor sanguinis, which occurs after the discharge of blood has ceased, is the true bond of union through which the process of healing must be carried on. Now the application of carbolic acid, and of numerous other analogous substances, checks the flow of blood by contracting and strengthening the living fibres, and it also protects the part against the influence of the atmosphere, which would be a cause of irritation, and therefore of morbid action in the injured tissues, whereby pus exudation would take place and union by the first intention become impossible. When the precautions adopted and insisted upon by Mr. Lister in the treatment of wounds are accurately carried out, it is evident that they include the jealous exclusion of atmospheric air as well as the contact of carbolic acid, by which combined measures the injured tissues are at once protected, strengthened, and stimulated. The testimony of surgeons is, on the whole, decidedly favorable to its use, as well to prevent suppuration in recent wounds, as to limit this process and to promote cicatrization in those which are already suppurating, and also in abscesses; but it does not possess any magical properties which entitle it to become a substitute for the other means whose value has been established by experience. The slight acceptance which it has found outside of Great Britain, and the extravagant eulogy showered upon it in that country, are presumptive evidence against its claims, which, in the language of a Parisian critic, may be thus disposed of: "I will neither deny the utility of carbolic acid in surgery, nor build upon a few positive facts to eulogize it; but it seems clearly to be in no way superior to substances ordinarily used as surgical dressings (*e. g.*, alcohol, glycerine, and various tinctures), nor more capable than they are of preventing those complications of wounds which every now and then infallibly occur."[1]

In various *diseases of the skin*, Dévergie made use of coal tar, with the effect of diminishing the unpleasant sensation produced by them, but not of curing them; Bazin destroyed the *itch* insect by a single application of a solution of one part of carbolic acid in one hundred of water; Dr. J. Watson cured *favus*, and also *alopecia areata* with a solution of one part of the acid in twenty-five parts of glycerine. It has been used, also, with more or less advantage in the treatment of favus, by Prior;[2] and it appears to be an efficient remedy, when taken internally, for the harassing itching of *prurigo senilis*, but it does not cure the disease. *Lupus* is said to have been cured by an ointment containing one-sixteenth part of the acid; and even *cancer* is alleged to have been very favorably modified by the acid, either pure or diluted according to the condition of the sore. But larger experience has proved it to be of very small value in these affections. According to Dr. Woodman[3] a solution of one part in forty, or, in some cases, of one in twenty,

[1] Labbée, Arch. Gén., 6ème sér., xviii. 468.
[2] Brit. Med. Journ., Oct. 1867. [3] St. Andrew's Reports, v. 228.

was of great service in cases of *noma pudendi* and other phagedenic and gangrenous affections of the pudenda and other parts in infants and young children after the acute exanthemata; but it is added that constant immersion of the parts in tepid water was associated in the treatment. It is also recommended as a sure remedy for *ascarides* of the rectum when administered by enema; but great care should be taken that the solution be not too strong. According to Mr. Turner, it cures soft *hæmorrhoids* by corrugating the integument. The same surgeon, with Sansom, Sedgewick, and others, commends it as a topical application in *diphtheria*. It is, at least, of service in correcting the fetor produced by the accumulation of putrid false membranes in the fauces. Other forms of pharyngeal and laryngeal disease, such as enlargement of the *follicles* and *ulceration*, are more or less benefited by pulverized solutions of carbolic acid; and the inhalation of such solutions is of signal advantage in *chronic bronchitis* of the simple form, as well as in that which usually complicates the advanced stages of *phthisis*, by diminishing the secretion, and thereby lessening the waste of substance, and the exhaustion occasioned by repeated and urgent coughing. A solution of fifteen or twenty drops of the acid in two pints of water, with the addition of one or two ounces of tincture of conium, or of alcohol merely, may be employed. In those not infrequent cases in which during *phthisis* and chronic *bronchitis* the secretions of the air passages acquire an exceedingly repulsive fetor, and even in the still more distressing case of *gangrene of the lung*, atomized inhalations of carbolic acid are of essential advantage in correcting this symptom, while in the first-named diseases it also limits secretion from the suppurating surfaces. If the state of the digestive organs does not forbid it, the acid may be internally administered at the same time. But it is much more useful by the latter mode in those forms of *dyspepsia* which are attended with fermentation and putrefactive changes in the food, and by distension of the stomach and bowels with wind, occasioning oppression in breathing and often great mental dejection. Although inferior to sulphurous acid in relieving this symptom, at least when it is of a gastric origin, it is nevertheless a remedy of real value in preventing both forms of decomposition of the food, which result in gaseous distension of the abdomen. When, however, this condition is the effect not merely of an imperfect supply of the secretions which naturally prevent the changes in food which were just referred to, but of an inflammatory state of the mucous membrane of the stomach, and especially of gastric ulcer, neither carbolic acid nor any chemical antidote to fermentation is appropriate. Such agents tend not to heal, but to irritate still further, the affected membrane; more efficient remedies will be found in sedatives and protectives, and, above all, in a bland and nutritious diet, especially one composed chiefly of milk.

It is unnecessary to more than mention that it has been locally applied to the treatment of *toothache*, *ophthalmia*, *nævus*, *venereal vegetations*, *boils and whitlows*, and various *uterine diseases;* and

administered internally for the cure of *intermittent fever*, *scarlatina*—*whooping-cough*, *phthisis*, the *nausea of pregnancy*, etc. The list of diseases might be greatly extended, which this agent, like all other newly introduced medicines, is alleged to cure; but an enumeration of them would serve no better purpose than to illustrate the credulity even of professional men, and their imperfect acquaintance with the laws of scientific evidence.

Administration.—Two officinal preparations of this medicine are described. *Glycerite of carbolic acid* (GLYCERITUM ACIDI CARBOLICI) is prepared by rubbing together in a mortar two troyounces of carbolic acid and half a pint of glycerin. *Ointment of carbolic acid* (UNGUENTUM ACIDI CARBOLICI) is made by thoroughly mixing sixty grains of carbolic acid with four hundred and twenty grains of ointment.

Carbolized oil is usually made with one part of the acid to six parts of olive oil.

The *dose* of carbolic acid is one or two grains, or of the liquid acid one or two drops. Glycerine forms a convenient and appropriate vehicle for its administration, which can be further diluted with water sweetened and flavored. For an atomized inhalation, from one to four or five drops may be mixed with an ounce of water to which a few drops of glycerine have been added. For a gargle about twenty drops of the acid in a similar vehicle may be employed.

AMMONII CARBONAS.—CARBONATE OF AMMONIUM.

History.—This medicine is said to have long been known to the Hindoos. It is prepared by the Tamools according to the following formula: Take of sal ammoniac one pollum, chalk two pollums, dry the ingredients carefully, then mix them and sublime with a strong heat.[1] In Europe it was first described in the thirteenth century by Raymond Lulli. He prepared it from putrid urine, whence it was called *spiritus urinæ*. Its chemical composition was determined by Berzelius in 1785.

Preparation.—When sal ammoniac (chloride of ammonium) is exposed to heat in an iron retort with chalk (carbonate of lime), a double decomposition takes place, and carbonate of ammonium is sublimed. This substance is not, however, a simple carbonate, but rather a hydrated sesquicarbonate, consisting of three equivalents of carbonic acid, two of ammonium, and two of water. According to another view of its composition, it is formed of one equivalent of the neutral carbonate, one equivalent of the bicarbonate, and three equivalents of water.

Properties.—Carbonate of ammonium occurs in commerce in the form of white, dry, hard, translucent lumps, of a fibrous crys-

[1] AINSLIE, Materia Indica, i. 367.

talline texture. Its smell is pungent, but less so than that of caustic ammonia, and its taste is acrid and alkaline, producing a protracted irritation in the throat. By exposure to the air it becomes converted into a dull white pulverulent mass, of inferior ammoniacal pungency, and which is the bicarbonate of ammonium. It is soluble in four parts of water at 60° F., and also in proof spirit, but is imperfectly soluble in pure alcohol.

Action. *On Animals.*—Orfila gave two and a half drachms of finely-powdered carbonate of ammonium to a dog of medium size. Two minutes afterwards, vomiting of yellowish and bloody matter took place. Six minutes later, convulsive movements began, and soon became general and frightful, affecting the muscles of the face, trunk, and extremities. These were succeeded by tetanic rigidity of the trunk in a backward direction. In twelve minutes the animal was dead. On examining its stomach, this organ was found to contain a good deal of bloody fluid, and its cardiac portion was deeply injected. A second experiment furnished similar results.[1] Mitscherlich, in his experiments upon rabbits, observed the following phenomena: Half a drachm of carbonate of ammonium dissolved in an ounce of water was injected into a rabbit's stomach. At first the animal became restless, but soon afterwards so feeble as to be unable to stand, spasmodic movements and tetanus followed, with rapid beating of the heart, and difficulty of breathing. There was no evacuation of the bowels. In twenty-five minutes the animal died. The stomach, on dissection, showed no alteration, perhaps in consequence of its containing food, but there was vascular injection of the upper portion of the small intestine, and the epithelium of this part was dissolved. The blood was liquid, and coagulated very slowly, forming a very small clot. When the salt was introduced into the cellular tissue of the abdomen, tetanic symptoms, as in the first experiment, occurred, and the animal died in forty-two minutes. As in that, also, decided lesions of the small intestine were found. Externally, it was very red, and within was filled with a reddish mucus, "which contained very few cylindrical cells, many cell-nuclei and globules, resembling the blood-globules in form and size, but so thin and delicate as readily to be torn.[2]

Seybert injected into the crural vein of a bitch fifteen grains of carbonate of ammonium dissolved in two drachms of water, without producing any peculiar symptoms, except general tremulousness and spasms of the abdominal muscles, which occurred more than two hours after the operation. By the next day the animal had entirely recovered. Some time afterwards it was again used for experiment, and twenty-five grains of the salt injected into its veins. No peculiar phenomena were observed beyond evidences of pain and convulsions at the moment of the operation, and no bad effects were visible on the following day.[3]

As general inferences from such experiments Mitscherlich states

[1] Toxicologie, 5ème éd., i. 323.
[2] Lehrbuch, ii. 287.
[3] Wibmer, Wirkung, etc., i. 133.

the following: Carbonate of ammonium given to dogs, in powder, produces gastric inflammation, extravasation of blood, and death by spasm. On rabbits its solution acts more feebly than caustic ammonia. It does not purge, but being absorbed it liquefies the blood, and does not render the urine alkaline. It has a specific action upon the small intestine (converting its epithelium into mucus), and equally so upon the spinal marrow, producing spasm.

On Man.—The only experiments with this salt upon healthy man with which we are acquainted were performed by Wibmer upon himself. But the doses he employed were too small to demonstrate its action. On one occasion he took six grains, which produced momentary uneasiness in the frontal region, and a sense of throbbing in the temples. After an interval of twenty minutes, he took six grains more, causing slight heaviness of the head and constriction about the temples. After another similar interval, the same dose was taken with like results, and finally, twenty minutes later, twelve grains dissolved in an ounce of water were swallowed. Apart from an irritative cough, and an increased secretion of bronchial mucus, no marked results ensued beyond what had already been observed. The appetite was not impaired. In none of the experiments was the circulation quickened beyond a few pulsations. Doses of twelve grains, according to Neligan, and of thirty grains, according to Pereira, occasion nausea or emesis.

The action of the salt, when used for a length of time, is probably different. Cazenave says that it produces pain in the abdomen, now and then diarrhœa, complete loss of appetite, a quick, frequent, and feeble pulse, paleness of the face, and loss of flesh and strength. But the suspension of the medicine for a few days usually dissipates these symptoms.[1] Long ago, Huxham wrote that this medicine, as a "volatile alkalious salt," tended to promote the acrimony and dissolution of the blood, and thereby promote its putrefaction. He states that when mixed with blood as it runs from a vein it quite destroys the texture of the blood-globules; and he further relates the case of a gentleman who was in the habit of eating it as other people do comfits. "The consequence soon was that he brought on a hectic fever, vast hemorrhages from the intestines, nose, and gums, every one of his teeth dropped out, and he could eat nothing solid; he wasted vastly away in flesh, and his muscles became as soft as those of a new-born infant; and he broke out all over his body in pustules, so that . . . . after several months he died tabid, and in the highest degree of marasmus."[2]

Pringle performed some experiments which show that carbonate of ammonium, so far from promoting the "putrefaction" of the blood, actually hinders this process, and he reasonably concluded that we should no more refrain from giving ammonia in low

[1] Bull. de Thérap., xxxi. 59.

[2] An Essay on Fevers, pp. 299 and 308.

fevers, because it induces dissolution of the blood when used long and immoderately, than we should reject salt as a condiment, because an exclusive use of salted meat occasions scurvy.[1] Moreover, it is only when the medicine has been taken for a long time that its supposed aplastic powers are developed, or exhibited. Pereira tells us that to an epileptic patient (a female), in the London Hospital, he gave fifteen grains of this salt three times a day for two months, without any apparent injury; and also that he had repeatedly prescribed a scruple three times daily for two or three weeks without any ill effect.

Uses. *In Low Fevers.*—If the immediate and principal operation of carbonate of ammonium were to diminish the plasticity of the blood, its benefits in scarlatina, typhoid pneumonia, glanders, poisoning by venomous reptiles, etc., would be inexplicable. Even more singular would be its efficacy in *typhus fever.* Huxham, misled by his theory respecting the action of the medicine, maintained that as in typhus the fluids are already unduly alkaline; "the exhibition of volatile alkalious salts to the sick is adding fuel to the fire; for they certainly dissolve or break the globules of the blood, and hence more speedily bring on general putrefaction."[2] Pringle, on the other hand, noticing this objection, replies that "they may be more efficacious in raising the pulse and expelling what is putrid, than hurtful by relaxing the fibres and resolving the blood. However, *it is from experience and not from theory*, that I take upon me to recommend the volatiles here."[3] Experience and theory, which here seem to conflict, may probably be reconciled by a reference to the facts above related, and by observing that while the very protracted use of the medicine is debilitating, its immediate influence is stimulating. The latter appears to be spent upon the nervous system, the former upon the blood. When therefore a temporary stimulant is required, it may be safely sought in this remedy, even in diseases which would be aggravated by its prolonged use. In a word, its operation in typhus is closely analogous to that of alcoholic stimulants, but whether it possesses any qualities which should give it the preference over these in typhus fever is not, we think, conclusively demonstrated. During the epidemic typhus which occurred in this city in 1836, it was largely used by the physicians of the Philadelphia Hospital, where most of the patients were treated. In his account of this disease, Dr. Gerhard says of carbonate of ammonium: "Although we are perfectly aware of its power as a rapid and effectual stimulant, particularly when the fever is complicated with a disease of the respiratory organs, we were rather disappointed in its effects. It was irregular in its action, and in the dull muttering delirium of typhus seemed totally without power."[4] Having occupied the same field of observation with Dr. Gerhard, we are able to confirm this statement, and must

[1] Diseases of the Army, pp. 315 and 316.
[2] Op. cit., p. 307. [3] Op. cit., p. 300.
[4] Am. Journ. of Med. Sci., xx. 320.

add that the repugnance to the medicine manifested by the patients was very great.

In *typhoid pneumonia*, in the pneumonia of persons advanced in life or of delicate or debilitated constitution, and when, towards the conclusion of the ordinary form, the strength fails and expectoration grows difficult, carbonate of ammonium becomes a valuable remedy, and may sometimes turn the scale in cases of imminent danger.[1] It is probable that in such cases it not only acts as a general stimulant, but also modifies the character of the pulmonary secretion, rendering it both less abundant and less viscid.

In 1802, Dr. Peart, of London, described his use of this medicine in a very malignant form of *scarlatina*, as being singularly successful. He directed two drachms of the salt to be dissolved in five ounces of water, and two teaspoonfuls of the solution to be given every two, three, or four hours.[2] Mr. Wilkinson, in 1822, extolled it extravagantly, declaring "that he not only never lost a patient in this disease, but never had a case of the malignant kind, that even appeared dangerous, or gave him a moment's anxiety."[3] Much more recently he confirmed his original statement, and extended its application to measles and other exanthemata.[4] In 1833, it was proposed as a specific in every form and stage of the disease by Strahl,[5] and subsequently Baudelocque and Botrel[6] found it singularly efficacious when the fever was marked by ataxic symptoms, delirium, subsultus tendinum, incrusted teeth, vomiting, a small irregular pulse, and involuntary discharges of fæces and urine, with a tardy or irregular eruption. Even in malignant cases, with the production of false membrane on the buccal mucous membrane and its continuations, with hemorrhage from the same parts, ecchymoses, delirium, adynamia, a small, frequent pulse, and anxious respiration, it sometimes availed to save life. In these accounts some exaggeration must be suspected, were it only because the disease continues to be, in its severer forms, one of the most fatal of its class. Besides, some cautious and experienced observers make a different report. Nevertheless, the value of the remedy is great, particularly when scarlatina assumes the low type it is apt to wear in the crowded dwellings of the poor. Under these circumstances, says Dr. Charles West, "I have found it desirable to give ammonia almost from the outset of the disease, ... and whenever the pulse presents the character of frequency and softness combined."[7] Dr. Balfour also speaks in strong terms of its efficacy;[8] Dr. Spooner has published several cases which strikingly illustrate its power in the severer and especially the adynamic forms of the disease;[9] and Dr. Down reports that of 192 cases, occurring in an asylum for idiots, and which included 78 anginose and 49 malignant cases,

[1] CHAPMAN, Therapeutics; WILLIAMS, Cyc. of Pract. Med., iii. 445.
[2] Med. and Phys. Journ., viii. 471.
[3] Ibid., xlvii. 396.
[4] Lond. Journ. of Med., Sept. 1851.
[5] Bull. de Thérap., x. 166.
[6] Ibid., xxxiv. 112.
[7] Dis. of Infancy and Childhood, 3d ed. p. 559.
[8] Edinb. Med. Journ., ii. 721.
[9] Boston Med. and Surg. Journ., May, 1862.

only about five per cent. terminated fatally, under the administration in every case of five grains of carbonate of ammonium in an ounce of water every four hours. A nutritious diet, also, and wine were liberally administered.[1] Under similar conditions it appears to have been very useful in *measles*.[2]

The carbonate of ammonium as well as the solution of ammonia has been recommended by physicians in the East and West Indies, and in the United States, as an antidote to the *bites of venomous serpents, insects, etc.* That the latter preparation will allay the pain and inflammation produced by the stings of bees and wasps is a familiar fact; and when this is taken in connection with the results of the employment of the carbonate in scarlatina and typhus, there would seem to be good reasons why the solution of ammonia should be used to counteract the symptoms produced by venomous serpents. If it does not directly tend to neutralize the poison, it at least co-operates with other diffusible stimulants in sustaining the system, until the natural powers eliminate the hurtful matter.

Like solution of ammonia, the carbonate may also be used to counteract the intoxicating effects of *alcoholic drinks*. When the patient cannot swallow, and the ammoniacal fumes are ineffectually applied to the nostrils, a solution of twenty or thirty grains of the carbonate may be administered by the rectum.

Dr. Mackenzie reports two cases of *glanders* in the human subject which were cured by this medicine administered in five grain doses every hour or two in conjunction with alcoholic stimulants and nutritious food.[3]

Under the name of "Peyrilhe's syrup," a nostrum consisting essentially of carbonate of ammonium was long celebrated for the cure of *chronic rheumatism*, *syphilis*, and *scrofula*. It required, however, to be used for many weeks together, and necessarily tended, if not carefully watched, to impair the strength seriously. Cazenave found the carbonate of ammonium a very powerful remedy in the graver forms of constitutional syphilis. He employed the formula recommended by Biett, as follows: ℞. Syrup of mezereon, ℥iv; syrup of tolu, ℥x; carbonate of ammonium, ℥j. S.—A tablespoonful night and morning.[4] The same writer has successfully prescribed carbonate of ammonium in several chronic affections of the skin which had been rebellious to other forms of treatment. This was particularly the case with *psoriasis*.[5]

In *chronic pulmonary catarrh*, whether complicated or not with emphysema, this medicine was employed and highly recommended by Laennec, Delioux, Guérard, Copland, and others, as favoring expectoration, and gradually causing the morbid secretion to subside. The following formula has been recommended: ℞. Camphor water, ℥iij; carbonate of ammonium, gr. xv. to xxx; syrup of tolu, ℥ss. S.—To be taken in tablespoonful doses in the course of twenty-four

[1] London Hosp. Reports, i. 158.
[2] Boston Med. and Surg. Journ., July, 1859, p. 484.
[3] Ranking's Abs. (Am. ed.), xviii. 230.
[4] Traité des Syphilides, p. 604. [5] Bull. de Thérap., xxxv. 59.

hours, and continued for several weeks. According to Rognetta,[1] it is chiefly useful in thin feeble children affected with obstinate chronic cough or whooping-cough, with or without tubercles, and whose condition forbids the use of depletion. Under somewhat similar circumstances it has been recommended by Hope, but particularly when an asthmatic attack is connected with disease of the heart.[2] It has also been employed in *croup*, internally, and externally as an ointment applied by friction to the sides of the neck.

Stierlin, who met with many cases of *broncho-pneumonia* and *bronchitis*, after a severe epidemic of measles, employed ipecacuanha, antimonial wine, and calomel, in their treatment. He was "horrified at seeing the strength of his little patients rapidly sink;" yet nothing could have been better fitted than those medicines to produce such an effect. Judiciously reversing the treatment, he prescribed carbonate of ammonium, and thenceforth had very few losses to deplore. The medicine was given in doses of one or two grains every hour or two.[3] Dr. A. Patton[4] states that during five years he treated ninety-six cases of pneumonia upon "the exclusive ammonia method," using no other medicine as a rule, and that of this number two only died. Dr. P. quotes the experience of other physicians to the same effect; one lost but two out of twenty-two cases; another, one out of thirty-five cases; a third, one case out of seventy-three. The general mortality was but one out of thirty-eight cases. These results are very favorable, and quite equal to those obtained elsewhere by an expectant method of treatment, including appropriate hygienic measures, but excluding all mere medicines.

Mr. Wallace, of Dublin, states that he cured severe cases of *cancrum oris* by the internal use of this medicine, beginning with doses of five grains repeated every two or three hours.[5] It may be surmised, however, that the local application of nitric acid and the nutritious diet prescribed by him at the same time, had more efficacy than the internal medicine.

The extreme *debility of stomach*, attended with vomiting and spasms, to which many drunkards are subject, is said by Chapman to be alleviated by carbonate of ammonium. In like manner it relieves *cardialgia* affecting pregnant women, and in *sick headache*, a dose of it will, in some instances, afford almost instantaneous relief. Alone, or associated with opium, it is a valuable remedy in *retrocedent gout* when its attacks are manifested by periodical colics, flatulence, cardialgia, and other symptoms of indigestion.

In 1840 Dr. Barlow proposed carbonate of ammonium in *diabetes*, as being at once a highly azotized substance and a diffusive stimulus. In four cases he found that it tended to restore the function of the skin, and so greatly to reduce the quantity of urine as to render the patients comparatively healthy.[6] Subsequent experience of his own,

[1] Annales de Thérap., vi. 50. [2] Dis. of the Heart (Am. ed.), p. 391.
[3] Edinb. Med. Journ., xvi. 463. [4] Am. Journ. of Med. Sci., Oct. 1870, p. 374.
[5] Dublin Hosp. Rep., vol. iv.
[6] Guy's Hospital Reports, v. 282.

and of Golding Bird, tended to confirm these results.[1] The same treatment has been found useful by Bouchardat.[2]

Siebold has highly recommended this medicine in cases of *puerperal convulsions* independent of an organic cause, but arising from irritability of the nervous system, and excited by debilitating influences. He used in connection with it, however, a great variety of other nervine and stimulant remedies, both external and internal. It is also one of the numerous remedies proposed for *epilepsy.* Pereira employed it extensively, and in many cases with obvious benefit. It should be given, he says, properly diluted, in doses of from ten to twenty grains. The form in which it proves most beneficial is that which partakes of the hysterical nature, "that syncopal form of epilepsy which Sauvages called lipothymia." Cases of *traumatic tetanus* have appeared to be favorably influenced by this medicine. One is reported in which the improvement and final recovery seem to have been due to solution of ammonia given every half hour in doses of six or seven drops. Probably the carbonate would have proved equally efficacious.

Carbonate of ammonium has been given as a sudorific in *acute and chronic rheumatism.*[3] Dr. Wood regards it as peculiarly useful when the disease, although febrile, occurs in an asthenic state of the system, probably dependent on impoverished blood, and is apt to be movable and accompanied with nervous irritation, a frequent and feeble pulse, a tendency to paleness, and perhaps coldness of the surface, and sweats during sleep.[4] The ammoniated tincture of guaiacum has long been used in the treatment of chronic rheumatism, and in this, as in the acute form of the disease, not improbably operates in the same manner as the other alkalies, and their combinations with vegetable acids, which have now become a part of the recognized treatment of rheumatic affections.

As an *antacid*, carbonate of ammonium may be administered with advantage to neutralize acidity of the primæ viæ, and to correct the *lithic acid* diathesis, but is less eligible than the other alkaline carbonates and the salts of the vegetable acids. In doses of thirty grains and upwards this medicine acts as an emetic without producing much nausea or depression, and may, therefore, be employed in chronic bronchitis occurring in broken-down constitutions, and wherever, in diseases of great debility, the bronchia becomes charged with mucus.[5] But the uncertainty of its operation renders it less eligible for these purposes than the sulphates of zinc and copper, or even mustard.

Like liquid ammonia, this salt may be used to stimulate the nasal mucous membrane in cases of *faintness*, *syncope*, *nervous spasms*, etc. Alone or mixed with half its weight of sal ammoniac and scented with an aromatic oil, it is familiarly employed as a smelling salt by nervous women, and particularly for the relief of nervous head-

[1] A Manual of the Prac. of Med., p. 519.
[2] Annuaire de Thérap. (Suppl.), 1846.
[3] CLARUS, Handbuch, p. 779.
[4] Therapeutics, i. 572.
[5] NELIGAN, op. cit., p. 205.

ache. It is not without advantage in the forming stage of *coryza*; by its substitutive irritation it often puts an end to the attack.

Externally, powdered carbonate of ammonium is sometimes sprinkled upon the surface of poultices applied to *glandular swellings*, and also for the removal of exudation matter and articular effusions. A salve is employed for similar purposes composed of from 60 to 120 grains of the salt to an ounce of lard, or a liniment made by adding to six fluidrachms of an animal oil 20 grains of carbonate of ammonium dissolved in about half a fluidounce of water.

Administration.—Carbonate of ammonium is generally given in watery solution, and its acrimony is blunted by the use of sugar and mucilage. It may also be given in an effervescing draught made by adding to a solution of *twenty* grains of the carbonate *six* fluidrachms of lemon juice, or *twenty-four* grains of crystallized citric acid, or *twenty-five and a half* grains of crystallized tartaric acid. As a stimulant expectorant, the dose is *two* or *three* grains or more, repeated every two or three hours. In low fevers, from *five* to *ten* grains should be given every hour or two. As an emetic, the dose is *thirty* grains.

ARNICA.—Leopard's-Bane.

Description.—Arnica montana (the flowers and root of which are medicinal, but the former only officinal) is a perennial herbaceous plant. It grows in dry and mountainous places and in hedgerows, in Northern Germany, and other northern countries of Europe. It is about a foot high, having simple or compound golden yellow flowers, and lanceolate, opposite leaves. The root is cylindrical, furnished with many fibres, of a brown color, and, like the flowers, has an aromatic odor, and an acrid nauseous taste. Both contain a volatile oil, which, however, exists more abundantly in the root, sixteen pounds of which, when dry, yield about one ounce of oil; both parts contain arnicin, an acrid resin, in about an equal proportion.

History.—The first mention of this medicine was made by Tabernæmontanus, one of the most eminent botanists of the sixteenth century. He states that it was a popular remedy among the Saxons for bruises, and other injuries accompanied with extravasation of blood. Its infusion was used to prevent or remove the effects of falls (hence it was called *panacea lapsorum*, *Fall-Kraut*, etc.), to cure obstinate intermittents, rheumatic pleurisy, chronic cough, suppression of the menses and lochia, and other affections in which pure stimulants are commonly employed. Collin, of Vienna, to whom we are chiefly indebted for its introduction into the Materia Medica, used it successfully in paralysis, amaurosis, putrid or typhoid affections, and in the diarrhœa of phthisis. Stoll affirmed its utility in several of these affections, but especially in asthenic dysentery. Indeed, Sprengel, from whom most of these

particulars are borrowed,[1] says that all physicians admit it to be one of the most potent and searching stimulants that we possess.

Action. *On Animals.*—Viborg administered an infusion of this medicine to horses, and found that, in moderate doses, it increased the action of the heart, the flow of urine, and the warmth of the skin, and that these effects were accompanied and followed by a full pulse, muscular tremors, and depression. In larger doses it produced similar effects in a more marked degree. When the same preparation was thrown into the veins of a horse, it occasioned a flow of saliva, heat of skin, general tremulousness, with roughness of the coat, labored breathing, and a full pulse. To these symptoms succeeded general depression, with drooping head and closed eyes. The animal could scarcely stand, and finally lay down quite insensible to all external irritants. Within two hours he perfectly recovered. Effects entirely similar, but of longer duration, were observed in a cow.[2]

On Man.—The local action both of the root and flowers of arnica is irritant; but that of the latter is the more powerful. Taken internally, arnica occasions a sense of irritation and burning in the fauces, with nausea, salivation, distension of the stomach, eructation, sometimes vomiting, and loss of appetite. It seldom disturbs the bowels, although in this respect the flowers are more active than the root. It also augments the heart's action and the frequency of respiration, the warmth of the skin, and both the perspiration and the urine. It appears to increase the bronchial secretion also, and occasions headache, giddiness, disturbed sleep, and pains in the back. If the dose be large, all of the functions are quickened, but dulness and a sense of weariness ensue.[3] The properties of the watery extract of arnica flowers, as tested by Schneller and other Vienna physicians, appear to be the same as those above attributed to the infusion. The local irritant operation of the medicine on the fauces and bowels was well marked, and also its stimulant influence upon the circulation. In several cases hemorrhage from the nose, or from the hæmorrhoidal veins, took place.[4] In large doses its action is very decided, and perhaps not without danger. A soldier, mentioned by Barbier,[5] took an infusion made with an ounce of arnica and six glasses of water, a glass every two hours, to cure an attack of intermittent fever. Soon after the first draught his breathing grew much oppressed, his head heavy and giddy, and the muscles of his limbs were affected with spasmodic movements. He was unable to rise, and fell when he attempted to do so. This condition lasted for half an hour, and every dose renewed it, but with diminished energy. In the case of a man who stated that he had taken by mistake an ounce of the tincture of arnica, the symptoms did not manifest

[1] Hist. de la Médecine, v. 472. [2] WIBMER, Wirkung, etc., i. 231.
[3] JÖRG, Materialien, p. 182; WIBMER, loc. cit.
[4] Zeitschrift d. Gesellsch. d. Aerzte zu Wien, März, 1846, quoted by STRUMPF, Handbuch, ii. 51.
[5] Matière Médicale, iii. 501.

themselves until eight or ten hours afterwards. He was in a state approaching collapse; the eyes were sunken, anxious, and glassy, the pupils dilated and unaffected by light; the pulse above 100, feeble and fluttering; the skin cold and dry. He complained of severe pain at the epigastrium. Under the use of heat, brandy, and opium he was, in a few hours, restored.[1] A woman, æt. 33, drank two cups of a strong infusion of arnica. In half an hour she vomited violently, had severe colic and choleraic diarrhœa, intense headache, then collapse with cold hands and feet and a pulse of 60, which, during the week that the illness lasted, rose to 80.[2]

Its popular use as a remedy for bruises would seem to indicate its possession of local stimulant properties; but Dr. Garrod, on testing it in comparison with simple spirit, applied to ecchymoses produced for the purpose with dry cups, could observe no difference between the actions of the two liquids.[3]

According to Richter,[4] this medicine is appropriate to diseases in which the powers of life are depressed, with diminished susceptibility of the system, torpor of the secernent organs, stagnation and obstruction, and also with a tendency to decomposition and gangrene. It is, he declares, peculiarly adapted to persons of a leucophlegmatic habit, but is contraindicated by augmented excitability of the nervous system, by general venous plethora, by active congestion of the brain or other important organ, and by great weakness and susceptibility of the stomach and bowels. When long used, it tends to confine the bowels, and in large doses is very apt to impair the digestion. In its stimulant action upon the nervous and muscular system it resembles seneka, but has not, like this medicine, a special influence upon the pulmonary mucous membrane. Neumann states that the infusion of the flowers excites nausea, while that of the root does not.[5] Oesterlen, one of the most eminent German writers on the materia medica, says that the use of this medicine is almost obsolete, or ought to be so, for it is quite superfluous, and of no greater value than any other mild stimulant.[6] This opinion is hardly warranted by facts; for the operation of arnica, whether on animals or on man, is not that of a feeble stimulant. Nor is it possible to suppose that such men as Stoll, Collin, Quarin, Hildebrandt, Hufeland, and Vogt have all been mistaken in supposing that they witnessed the effects which they ascribe to its use.

Uses.—Stoll prescribed the decoction of arnica (℥ss to ℥j of the flowers in a sufficient quantity of water to make a quart of the decoction, sweetened, and given in doses of a cupful every two hours, or half of this quantity every hour) in "*putrid fevers*," when there was no inflammatory complication and the pulse was natural, while the strength and all the animal functions were very much depressed; also when the tongue was dry or covered with an abun-

[1] Times and Gaz., Nov. 1864, p. 571.
[2] Bull. de Thérap., lxxvi. 235.
[3] Times and Gaz., Jan. 1864, p. 117.
[4] Ausfürliche Arzneim., ii. 142.
[5] Heilmittellehre, p. 93.
[6] Ibid., p. 498.

dant and foul mucus, or when the patient was dull, sluggish, and deaf, with muttering delirium. He generally preceded its administration by an emetic. It usually gave rise to flatulence and colic, but lessened the stupor. Sometimes the first doses excited vomiting, and nearly always they produced nausea.[1] Collin recommended it under similar circumstances; and Hildebrandt, while he points out, like Stoll, that it is very unpleasant to take, and frequently occasions nausea, yet alleges that sometimes its relief of stupor, vertigo, and delirium is very decided, and that it tends to restore the functions of the skin.[2] It is equally recommended by Voigtel, particularly when abdominal distension and other intestinal symptoms are very marked.[3] Richter advises it in various *typhoid conditions*, as in puerperal fever, typhoid pneumonia, and in the later stages of the ordinary form of pneumonia, when expectoration is difficult and the depression of the system great (in combination with senega), and also in advanced stages of inflammatory affections of the brain. In certain *intermittent fevers* Stoll vaunted this remedy, which he used in the form of an electuary. It generally produced severe pains in the stomach, with a copious viscid perspiration, a full, slow pulse, and constipation of the bowels. He allayed the gastric spmptoms with opium. This method, he states, transformed triple into double quartans, and these into simple quartans, which disappeared without relapse.[4] The same physician, by means of this remedy alone, cured patients reduced to the last extremity by hectic fever, colliquative sweats, and diarrhœa, from suppuration, and who had previously taken large doses of bark in vain; so that, he remarks, "with its aid I did not despair when all seemed desperate." If the case was urgent, he administered a drachm and a half of the powdered root every two hours, and found that it rarely excited vomiting, or only in the beginning.[5] In the epidemic and typhoid form of *dysentery*, he declared that he knew of no remedy more justly entitled to be called a specific.

Arnica has been recommended in various forms of peripheral *paralysis*, as of the bladder and of the auditory nerve; also in advanced periods of central paralysis, after the complete subsidence of all inflammatory and irritative phenomena. In extravasations of blood, or *bruises*, after the tendency to inflammation has subsided, or been overcome by antiphlogistic agents, this remedy has been praised by Richter, as it was originally by the popular voice. The author named remarks as follows: sometimes powerful concussions and contusions of internal as well as external parts give rise to a state approaching paralysis both of the nerves and bloodvessels, from which passive congestion and swelling are apt to arise. Under these circumstances arnica given as early as possible, is decidedly the most effectual remedy. But the doses must be large.

Arnica has also been vaunted, but on more equivocal grounds, in

[1] Médecine pratique, ii. 99.
[2] Du Typhus Contagieux, p. 210.
[3] Arzneimittel., ii. 133.
[4] Op. cit., ii. 104.
[5] Ibid., ii. 453.

all kinds of *spasms* and *dropsies*, in *rheumatism* and *gout*, in *passive hemorrhages*, etc. Dr. Neligan states that he found a tincture of the flowers useful in *nervous headache.*

Externally fomentations made with the flowers of arnica, or lotions with its tincture, have been commonly employed for the relief of bruises, sprains, and local paralyses. It is, however, probable that alcohol alone would be equally efficient. Neumann recommends fomentations of the flowers in vinegar. Powdered arnica flowers are stated to have been successfully used as a dressing to arrest the progress of mortification. The dry powder is sometimes employed as an errhine.

Administration.—The powdered root may be given in doses of *ten* to *thirty* grains, several times a day. A *decoction* may be made with from 120 *grains* to *an ounce* of the root in *nine fluidounces* of water, reduced to *six ounces.* Dose, a tablespoonful every two hours. The *infusion* is made with from 60 *grains* to *an ounce* of the flowers in *six fluidounces* of water. The liquid should be carefully strained, so as to exclude all filaments. Dose, a tablespoonful every two hours. The *tincture* (TINCTURA ARNICÆ) is made with arnica flowers ℥vj, alcohol Oiss, and enough diluted alcohol and water to obtain two pints of tincture. Dose, fifteen to thirty drops.

TOXICODENDRON.—POISON OAK.

"The leaves of *Rhus Toxicodendron.*"

Description.—*Rhus toxicodendron* and *R. radicans* are natives of the United States, and are not distinct species, but only varieties of the same plant. "I have frequently observed," says Dr. Bigelow, "individual shoots from the same stock having the characters of both varieties. I have also observed that young plants of *R. radicans* frequently do not put out rooting fibres until they are several years old, and that they seem in this respect to be considerably influenced by the contiguity of supporting objects." *R. toxicodendron* is popularly known as *poison-oak*, and *R. radicans* as *poison-vine.* The former is an erect shrub about three feet high, and its leaves are more toothed and lobed than those of the other variety; the latter is a climbing vine, with broad ovate acute leaflets, smooth and shining on both sides, but sometimes pubescent beneath, and bearing small greenish-white flowers and globular pale-green or whitish berries.

History.—The poison oak, says Griffith,[1] was early noticed, and was described in 1635 by Cornutus as a species of ivy. It was known to the Indians both as a poison and a medicinal agent, and the effects of emanations from it were mentioned by Kalm and other travellers in North America. Kalm furnished a detailed and accurate account of the symptoms produced by its action on the skin. In 1788, Du Fresnoi, an army surgeon of France, pub-

[1] Medical Botany, p. 184.

lished an account of its supposed virtues in the treatment of cutaneous eruptions and of nervous paralysis.[1]

Action. *On Animals.*—Herbivorous animals, such as goats and cows, eat the leaves of this plant with impunity, but they affect dogs as a poison. According to Rossi, its juice, given to a dog with his food, produced mortal convulsions; and Van Mons relates that a large dog, exposed during a night to the emanations of the plant, died with general swelling of the body.[2] In Orfila's experiments upon dogs it appeared to exert a depressing influence. Introduced into the stomach of the animals, they were affected with giddiness and inability to walk; the pupils were dilated, and death took place without stupor or convulsions.[3]

On Man.—According to Horsefield, when taken *internally*, it displays the properties of an acro-narcotic, and in small doses those of a direct stimulant, causing heat and uneasiness, and afterwards promoting perspiration and diuresis. Dufresnoy states that in many persons an infusion of the fresh leaves causes prickling and smarting of the skin; in many, also, nausea, gastric pain, dizziness, headache, and pain and twitching in paralyzed parts.[4] Giacomini, on the authority of Van Praag, says that it gives rise to gay excitement, with nausea and vertigo, confusion of the senses, a sense of stricture of the temples, chilliness, thirst, a slow, small, and irregular pulse, diaphoresis and diuresis, trembling and convulsions, general faintness and debility, etc.[5] Clarus, besides stating that the dried plant exerts no action whatever upon the skin, and contains neither a fixed acrid or narcotic principle, nor any alkaloid, affirms positively, but very incorrectly, that its extract and also its fresh juice are totally inert as regards men and animals, both in health and disease.[6] Dr. J. W. Moorman relates the cases of two children, one six and the other eight years of age, who, between them, ate nearly a pint of the berries. In a few hours they became drowsy and stupid, and in a short time vomiting commenced, first of the partially digested fruit, afterwards of a thick, tenacious fluid of a wine color. Then convulsions of different parts of the body followed, accompanied by slight delirium. Respiration was hurried, the pulse at first full, strong, and slow, but afterwards small, frequent, and compressible. The pupils were dilated. Both children recovered.[7]

The action of this plant upon the *skin* is familiarly known. It may operate by contact, however slight, or without contact; probably through the medium of an effluvium which it exhales. This is said to be more active by night and in cloudy weather. Van Mons inverted a covered glass vessel over a portion of the foliage of the plant, and subsequently his brother, on placing his hand within the vessel, experienced a sensation of heat and smarting, which was

[1] Mérat and De Lens, Dict. de Mat. Méd., vi. 80.
[2] Dieu, Mat. Méd., iv. 581.
[3] Toxicologie, ii. 132.
[4] Wibmer, op. cit.
[5] Mat. Med., p. 561.
[6] Prager Viert., lxxvi., Anal., 19.
[7] Am. Journ. of Med. Sci., April, 1866, p. 560.

followed by the usual inflammatory symptoms. Some persons appear to be much more susceptible to its influence than others; indeed, the greater number experience no ill effects from it. This peculiarity is explained by supposing the skin of those persons who are obnoxious to its action to be unusually delicate. "The symptoms caused by it are violent itching, redness, and tumefaction of the affected parts, especially of the face, succeeded by heat, pain, vesication, and fever. In some cases the skin becomes covered with a crust, and the swelling is so great as to obliterate the features. These symptoms begin in a few hours after exposure to the poison, and are usually at their height on the fourth or fifth day; after which desquamation begins, and the disease diminishes. In some instances the eruption is less general, and is confined to the part exposed to actual contact with the poison; in others, again, the eruption continues for a long time, one set of vesications succeeding another, so as to protract the disease for an indefinite period." (*Griffith.*) Lavini applied two drops of the juice of the plant to his finger. It was not until twenty-five days afterwards that any result occurred, when he experienced heat in the mouth and throat, and swelling of the face; and the next day the forearm was greatly swollen, and vesicles appeared where the juice had been applied as well as on other parts of the limb.[1] In a very interesting and fully detailed case reported by Dr. Sanders,[2] a man, while plucking the young shoots of the plant, had his hands stained by its milky juice. The symptoms did not make their appearance until the fourth day; not only were the hands and arms affected, but the face, the genitals, and other parts which had been touched by the fingers.

Uses.—This medicine has been vaunted as a remedy for cutaneous eruptions on the ground apparently of its having cured such diseases by exciting a substitutive inflammation. It has also been used in the treatment of paralysis. Trousseau affirms that its efficacy is unquestionable in cases of *paraplegia* from concussion of the spinal marrow and other affections of this organ without destruction of tissue. He recommends that a dose of five grains should be given the first day of the treatment, and increased daily by the same amount until sixty grains are taken every day. It is said to occasion no inconvenience, and to strengthen rather than enfeeble the digestion. Sometimes a slight degree of strangury is observed. This action upon the spinal cord and bladder appears to be confirmed by cases in which it relieved incontinence of urine depending upon atony.[3] A remarkable illustration of its apparent power is furnished by its cure of paraplegia connected with rheumatic exostoses of the spinal column. It is stated to have removed the abnormal growths as well as the paralysis.[4]

[1] Wibmer, Wirkung, etc., iv. 406.
[2] Edinb. Med. Journ., xiii. 714.
[3] Annuaire de Thér., xx. 58.
[4] N. Am. Med.-Ch. Rev., v. 154.

PHOSPHORUS AND THE HYPOPHOSPHITES.

Description.—Phosphorus was discovered in 1669 by Brandt, of Hamburg, who extracted it from putrid urine. About a century later it was found by Scheele, in bones. It is abundant in many plants, especially in the cereal grains, and in animals its proportion is largest in the most and in the least vitalized organs, in the nervous system, and in the bones. It is obtained from the phosphate of lime in the latter by calcining and powdering them, and treating them with sulphuric acid largely diluted, by which means a superphosphate of lime remains in solution. After reduction to a syrupy consistence and the addition of powdered charcoal, the mixture is distilled, the oxygen combines with the charcoal, and the phosphorus is deposited under water. It is a semitransparent solid, usually of a pale-yellowish or buff color, with an alliacious smell. It is soft and flexible, and its section has a waxy aspect. It inflames at 100° F., and is less rapidly oxidized at a lower temperature with emission of whitish fumes which are luminous in the dark. Phosphorus dissolves readily in chloroform and in bisulphide of carbon, but it is sparingly soluble in ether, pure alcohol, and oils. It is always preserved in water, in which it is insoluble. Its combination with oxygen, *phosphoric acid*, is officinal in a diluted form, *acidum phosphoricum dilutum*, of which six fluidrachms contain 35.5 grains of anhydrous phosphoric acid. The other officinal preparations of phosphorus include *phosphate of iron* and *phosphate of sodium*, and the *hypophosphites of calcium*, *iron*, *potassium*, and *sodium*.

Action. *On Animals.*—It is stated by Strumpf, that, when phosphorated oil is rubbed into the skin of certain animals, its vapor is speedily perceived by the garlic-like odor of the breath, and in the dark by luminous fumes. The odor is also perceptible in the sweat and the urine. Liedbeck applied to a wound in a dog's neck half a drachm of granulated phosphorus. The animal showed great distress and exhaustion, had dilated pupils, refused food, and died on the eighth day. Animals poisoned in this manner are stated to have the blood more fluid and also darker than natural, the liver studded with minute specks of a lighter color than the rest of the organ, and the kidneys firmer and yellower than natural. In these experiments no care was taken, apparently, to protect the phosphorus from the action of the air, but in more recent ones performed by Ramier,[1] who placed fragments of phosphorus beneath the skin of frogs, guinea-pigs, and rabbits, no inflammatory phenomena, such as an inert foreign body produces, were occasioned by them, but, in the case of the frogs at least, which did not die until two or three weeks after the operation, the liver and kidneys were found to have undergone fatty degeneration. Dujardin-Beaumetz states, that when phosphorus is administered internally to animals in moderate doses, or in such as are not rapidly fatal,

[1] Mém. de la Soc. de Biologie, 1866.

although the circulatory system is not affecte d, the nervous system is usually stimulated in a marked degree. Thus, a rabbit to which the daily dose of a milligramme of phosphide of zinc was given became so sensitive that he made prodigious leaps whenever he was touched, and struggled with and bit the person who administered the medicine. It is related that Pelletier, having left a copper vessel which contained some phosphorus in his courtyard, a combination of the two substances took place, and water was added to dissolve it, which a drake and some ducks drank. They were all killed by the poison, but the erotic fury of the male animal was such that he perished before the others.[1] Dr. Godman, of Philadelphia, relates the following: A valuable bitch, five years old, had never been in heat, when phosphorus in the dose of one and then of two grains was given her without effect. After a fortnight a dose of three grains was administered. Within an hour or two signs of excitement of the external organs of generation became apparent, with repeated attempts to urinate. After a couple of hours these symptoms subsided, and then the animal was beset by a large number of males, was lined by one of them, and in due time gave birth to three pups. On another occasion two grains of phosphorus were given to a boar. The animal had previously been lying still, but soon afterwards he arose, his bristles erect, and panting with excitement, he endeavored to cover a sow.[2] Poisonous doses given to animals occasion more or less distinct signs of gastric inflammation, and death by asthenia or in convulsions. On dissection, the stomach usually presents injection, softening, and ulceration of the mucous membrane, and there is sometimes peritonitis; but in other cases, apparently when the poisoning has been slow, no gastric lesions are observed. The blood in the lungs, right side of the heart, and the large veins, is dark and fluid.

On man.—Often after a *poisonous* dose of phosphorus is taken no active symptoms are observed for hours, even for as many as eighteen. The first is generally vomiting, but in mild cases, even this symptom may be absent, but there is usually eructation of gas of a garlicky odor, and the ejecta, if there are any, are luminous in the dark. Meanwhile there is burning heat in the throat and stomach, which also gradually extends to the whole abdomen, which is distended and tender, except in very slight cases. There is thirst, the tongue is white, the stools are firm or loose, and in the latter case sometimes bloody; they are also phosphorescent in the dark, as are also the matters vomited. These are apt to be dark, sometimes bloody, and exhale the characteristic smell. From the second to the fourth day, if the patient survive so long, and in mild as well as grave cases, jaundice usually occurs. In some blood is passed by stool and in the urine, and may exhale from the gums, or appear as ecchymoses of the skin. Pain in the head, giddiness, fainting, sleeplessness, delirium, and coma, with convulsions in

[1] Mém. de la Soc. Méd. d'Emulation, 2ème éd., i. 260.
[2] Phila. Journ. of Med. and Phys. Sci., xiii. 193.

some cases, succeed one another until the end, which, if convulsions occur, is usually, but not always, fatal. In other instances again death is owing to exhaustion, the mind remaining clear. In exceptional cases sexual excitement is observed. If death is not the direct result of acute phosphorus poisoning, yet the digestive functions may remain long or permanently disordered, and the muscular system continues feeble, irritable, and disposed to spasm, convulsions, or paralysis. *After death* the interior of the body in every part is phosphorescent in the dark, the stomach is seldom widely inflamed, but chiefly in the pyloric extremity, where there may also be some ulceration, and the organ is apt to contain a bloody liquid. The liver is of a light yellow color, and it, as well as the kidneys, heart, and voluntary muscles, shows more or less distinct signs of fatty degeneration. The gall bladder is usually flaccid, and contains a pale yellowish liquid.

The symptoms of *chronic phosphorus poisoning*, such as is observed among lucifer match makers, for instance, are briefly these: bronchial irritation and dyspeptic derangements, followed by a cachectic condition in which the skin is straw-colored or grayish, extreme sensitiveness to cold, formication and stiffness, and numbness of the limbs, softening, abscess, and ulceration of the gums, loss of the teeth, caries and necrosis of the jaw bones. These symptoms are accompanied with a hectic fever, and if the patient continue to work in phosphorus, he either dies worn out by the lesions mentioned, or of tubercular consumption of the lungs.

In *moderate doses*, $\frac{1}{40}$ to $\frac{1}{4}$ gr., phosphorus occasions more or less of the following effects: a sense of warmth in the stomach followed by a similar feeling over the whole body; the pulse will generally become fuller if not more frequent, the secretion of urine is augmented and exhales the characteristic aliaceous odor, the muscular activity appears greater, the mind is stimulated, a general sense of exhilaration is felt, and a disposition to venereal indulgence.

Uses.—In a work on Therapeutics and Pharmacology, published in 1872, M. Rabuteau uses the following language: "I conform to usage in speaking of phosphorus as a medicine; but I do not hesitate to say that this poisonous substance never cured any disease, but has always hitherto been not only useless, but dangerous through the poisoning it may immediately, and the fatty degeneration it may remotely, cause." And Strumpf prefaces his account of its therapeutical applications with the remark that it is only in very exceptional cases, and when the depressed nervous system will respond to no other stimulant, that it should be employed, and then with great circumspection, and a minute attention to the conditions which alone can render its administration safe. The precautions he insists upon, it is perhaps unnecessary to repeat in detail; suffice it to say that the most important are the following: Phosphorus should never be given on an empty stomach, nor without being mixed with honey, or dissolved in ether in an emulsion; it should never be associated with camphor, nor with oxides of mercury; it is contraindicated in tuberculous and ulcerative phthi-

sis, and in dysentery, etc. Nevertheless he finds sufficient evidence of its utility in the exhausted conditions of *typhoid diseases*, when the system fails to respond to more ordinary stimulants; in the *debility* of old persons; in certain cases of *amaurosis*, *epilepsy*, *paralysis*, etc. Dr. Thorowgood[1] maintains the very rational position that in many nervous diseases there is as much reason for the administration of phosphorus for supplying the waste of this element, which is made manifest by the excess of phosphates in the urine, as there is for the exhibition of iron in anæmia; but however rational the opinion may be, it is not as fully justified as was to have been expected by clinical experience; and this writer is fain to confess that in the form of hypophosphites the medicine is more eligible than in its natural condition. Undoubtedly in these compounds phosphorus may be administered in so low a state of oxidation as to retain most of the virtues of phosphorus itself without the risk involved in using it uncombined. Yet in many chronic nervous affections pills of phosphorus and phosphorated oil have been employed with advantage by Drs. Radcliffe, Althaus, Delpech, Anstie, Tavignot, Dujardin-Beaumetz, Ranvier, and others. The affections which seem to have been most benefited by these physicians were *paralysis*, *locomotor ataxia*, and *chronic bronchitis*. In the last, Dr. Thorowgood speaks emphatically of the value of the hypophosphite of potash in five grain doses, but he prefers the hypophosphite of soda or of lime to the potash salt as a gradual tonic and restorer of failing nervous force. In cases of nervous depression and torpor, with occasional neuralgic pains or a sense of numbness or deadness in the limbs, the hypophosphite of lime or of soda may be administered, along with iron or not, according to the special condition of the system. The most commonly appropriate associate of the hypophosphites is, however, quinia, as having, like them, a special tonic influence upon the nervous system. Iron, on the other hand, is more frequently contraindicated than required, and if associated with the other medicines without distinct indications for its use, is apt to occasion fulness of the head, and to impair digestion instead of improving it.

Within the last few years phosphatic compounds have been much employed in *anemic*, *scrofulous*, *tuberculous*, and other *cachectic* conditions. Beneke informs us[2] that he obtained excellent effects from phosphate of lime in doses of two or three grains three times a day associated with a little chalk or with cod-liver oil, in acid dyspepsia with a *chlorotic* complexion; also in marasmus, affecting scrofulous children; in exhaustion from undue *lactation;* and in cases of obstinate scrofulous ulcers. He regards this preparation as useful in commencing tuberculosis affecting adolescents, with loss of flesh and a chlorotic aspect; in *syphilitic* ulcers and various cutaneous eruptions occurring in feeble, thin, cachectic persons; and finally in the *menorrhagia* of young girls. On the other hand, he has not found it advantageous in caries of the bones in adults;

[1] Practitioner, iii. 14. [2] Arch. f. Wissens. Heilkunde, ii. 460.

in fully developed tuberculosis, in scrofulous persons with a delicate ruddy complexion; or in thin, feeble, and nervous persons laboring under chronic abdominal affections. In certain experiments of Dusart it was found that in animals consolidation of fractured bones took place more rapidly when phosphate of lime was given them, than when it was not. He also found it to hasten the consolidation of *fractures* in the human species when it was given in the daily dose of sixty grains for a week at a time, and afterwards in larger doses. It was dissolved in lactic acid. *Rickets* and *Pott's disease of the spine* have both been favorably influenced by the phosphate of lime. It need scarcely be added that its administration should not be allowed to exclude that of iodine and cod-liver oil.

In 1858, Dr. J. F. Churchill put forth the idea that a decrease in the proportion of phosphorus in the system is the immediate cause of *tuberculosis*, an hypothesis which, if correct, clearly indicated a cure of the disease by phosphatic remedies. On using the hypophosphites of soda, and of lime, which he preferred as being very soluble, he found that they produced "a manifest increase of nervous power sometimes even from the first day of their administration, together with an unusual feeling of comfort and strength. . . . . The appetite increased, often in an extraordinary manner. The evacuations became regular and more abundant; the night-sweats, if they had existed, ceased; sleep became calm and profound." He administered the medicine to thirty-five consumptive patients, all of whom were either in the second or third stage of phthisis. "Of these, nine were completely cured, eleven experienced great melioration, and fourteen died." More recently, Dr. Churchill published a series of cases,[1] from which he concluded that "in the present state of medical science, phthisis, when not treated by the hypophosphites, at whatever period of its development it may be observed, and whatever stage it may have reached, must be regarded as almost always fatal." Without criticizing a proposition which is manifestly incorrect, we subjoin the contrasted effect which the hypophosphites are said to produce: "Phthisis in the first stage always ends in recovery; and it always ends in recovery in the second stage, provided one lung only is affected." Many other minor results are presented as the effect of Dr. C.'s medication, but these two, as the greatest, include all the rest. Unfortunately, as so often happens, the remedy has had but little success in the hands of other physicians. In 1858, at the London Hospital for Consumption, Dr. Cotton found it of no avail;[2] in 1861 he concluded that it exerts no specific action, that it is, even when useful, inferior to other remedies, and that it often seriously disturbs the stomach and bowels;[3] and in 1868 he declared that except in cases associated with acid dyspepsia (in which the hypophosphites have the same effect as the alkaline carbonates), they are absolutely harmful by excluding more appropriate remedies.[4] A substantially similar verdict was

[1] Med. Circular, 1862–3.
[2] Times and Gaz., Feb. 1858, p. 163.
[3] Ibid., July, 1861, p. 7.
[4] Ibid., Nov. 1868, p. 555.

rendered by M. Dechambre in Paris.[1] Dr. Quain, after a fair trial of the hypophosphites in phthisis, pronounced them to be "comparatively, if not absolutely, useless;"[2] and of twenty cases reported by Dr. J. R. Bennett there were only nine in which the disease did not steadily advance while under treatment. Of these nine, four only manifested any decided improvement, but of its permanency there was no proof in any case.[3] Mr. Taylor, of Liverpool, while claiming for the hypophosphites a power of temporarily ameliorating many of the symptoms of the disease, alleges that in his workhouse patients "the disease seemed all the more rapidly to run its course to a fatal termination under the influence of the hypophosphite of potash." He found, nevertheless, that in exhaustion from prolonged lactation; dentition in strumous children; leucocythemia and anæmia; and from catarrhal, leucorrhœal, and purulent discharges; also in myalgia and muscular pains, simulating inflammation, the hypophosphite of soda or potassa was often useful.[4] It may be added to these statements that Dr. F. W. Lente, after a careful trial of the hypophosphite of potassa in phthisis, reported that "the effect of the salt was negative."[5]

Administration.—The hypophosphite of lime may be given in doses of five or six grains with the meals, and the hypophosphite of soda in doses of eight or ten grains during digestion.

SERPENTARIA. Vid. *Diaphoretics.*

[1] Bull. de Thérap., lv. 427.
[2] Lancet, March, 1860, p. 267.
[3] Times and Gaz., April, 1861.
[4] Lancet, Nov. and Dec. 1861.
[5] Am. Med. Times, vii. 37.

Class VI.

CEREBRO-SPINAL STIMULANTS.

In no department of the Materia Medica is classification so difficult as in that relating to medicines which affect the nervous system. Until recently their division into narcotics and antispasmodics was deemed sufficient. The former class contained all the agents which diminish sensibility, and the latter all which allay irritability without affecting sensibility. But a minuter examination and analysis of the phenomena produced by members of the two classes showed that they differ greatly from one another in regard to the particular functions which they appear to control. Thus, in the former, opium, whose force is expended chiefly upon the brain, was associated with conium, which, even in fatal doses, scarcely impairs the consciousness, and with aconite, which does not directly affect the brain at all. Similar differences, often essential and radical, became apparent, and, indeed, were multiplied when the experimental analysis of primary nervous functions showed that they are quite distinct from one another, and are really so far independent that in different series of the animal kingdom each may exist alone. Thus, in the lower orders, which possess neither spinal marrow nor brain, the ganglionic system controls all vital processes; in a higher class the spinal axis is superadded; and in a still more elevated sphere a brain, endowed with various faculties in degree and kind, and in man attaining its fullest development, perfects the fabric of the nervous system. In him it is at once most complex and complete, for while all the processes of his organic life, and all his animal functions, are as perfect as in any other creature, he stands alone possessed of an organ by means of which he can combine ideas, create imaginary conditions, and be affected by thoughts of future events.

On each of these diversified functions of the nervous system there are medicines which exert a special influence. Some act upon the brain chiefly, as the true narcotics; others exclusively upon the spinal marrow; and some have a special influence upon the nerves of organic life, or the ganglionic system, controlling through it nutrition and the action of the heart, lungs, and alimentary organs. A further analysis of the medicines which modify the functions of nervous system demonstrates that some among them act as stimu-

lants and others as sedatives of the whole system, or of the brain, the spinal marrow, or the circulation. Hence, it is seen that, instead of the arrangement in two classes, we must recognize several new ones, formed chiefly, however, out of original narcotics. In the further examination of them it will be apparent that several of the individual agents might not improperly occupy other places than the ones assigned to them; for it is peculiarly true of medicines belonging to this general division, that their action is, in a great degree, determined by their dose, and by the condition of the system at the time of their administration. Especially is this remark applicable to antispasmodics as a class, for their properties are scarcely exhibited except in the morbid states for which they form appropriate remedies.

NARCOTICS.

The term narcotic is now applied to medicines which induce *sleep;* but in all except the most recent systematic classifications it also includes those which in any way lessen the *sensibility* of a part. The latter use of the word is more in accordance with its etymology, for it is derived from the Greek verb ναρκεω, which means to benumb, stiffen, or render torpid; and although some medicines produce their effect chiefly by diminishing the perceptive power of the brain, and others exclusively by their local action upon the nerves, they agree in palliating the sensation of pain. This distinction is not of modern invention, but is evident in the very terms which were anciently employed. *Hypnotica*, *soporifera*, and *somnifera* were the epithets applied to the former, and *anodyna* and *paregorica* to the latter group of narcotics. It is the former that we propose at present to examine, while the latter will be considered among antispasmodics and sedative medicines.

When narcotics are spoken of as medicines that produce sleep, it must be understood that reference is made to their direct and essential operation. For wakefulness may be due to a great variety of causes, some of which are direct and others indirect. The former may reside in the encephalon itself, and consist of purely mental excitement, which implies arterial hyperæmia, or of purely material conditions, which may be sthenic, as in inflammation, or asthenic, as in debility consequent upon excessive stimulation. The indirect causes comprise all forms of irritation or pain in parts remote from the brain. Many medicines which are not narcotics, and many agents which are not medicines, may remove the cause of wakefulness, and thus indirectly occasion sleep. But true narcotics produce sleep, both when no influences are operating to prevent it, and often in spite of such influences, by exerting a more powerful action than theirs, and one of an opposite nature. It is, indeed, their peculiar virtue to blunt the senses and steep the mind in forgetful-

ness, in spite of pain, of nervous irritability, and of tormenting thoughts.

But, when the entire group of narcotics is examined, they are found to possess the power of producing sleep in very different degrees, so different, in fact, that if those articles are excluded which have been placed in other divisions of medicines affecting the nervous system by some authors, and those to which hypnotic virtues have been denied by others, opium only remains as the representative of the class, or rather constitutes this class alone. Thus, hyoscyamus, belladonna, and stramonium are expressly stated by Mr. Headland to be "not soporific;" Tully refuses the same quality to lactuca and humulus, and classes cannabis with euphrenic, as the first-named author ranks it with inebriant medicines. But the different articles mentioned are generally, and we believe correctly, regarded as possessing true hypnotic virtues, however feeble these may be in the case of some among them; while it cannot be denied that they become indirectly promoters of sleep in consequence of their anodyne or paregoric virtues.

The primary effect of narcotic medicines, except perhaps lactucarium and humulus, is to excite the mind and indeed all of the functions, and at the same time to blunt the perception of external things as well as bodily sensations. This doctrine has not always been acknowledged. On the contrary, one of the most acrimonious of the disputes which have divided the medical world grew out of the question whether opium is a stimulant or a sedative. Cullen maintained that narcotics "are universally and directly sedative;" yet, in almost the same page, he declared that "in their first operation they often increase the force and frequency of the heart's action." And, as if to complete the confusion of his description, he asserted "that the stimulant and sedative powers of opium operate at one and the same time."

Undoubtedly the primary action of opium, as well as of other narcotics, with the exceptions above mentioned, is to stimulate the whole system, and often in so violent a degree as to occasion delirium. But they may become sedative in their secondary operation, and that in one of two manners: either by blunting the sensibility of the system to pain or other cause of excitement, or, when given in excessive doses, by directly reducing the powers of life, and occasioning a torpor resembling that which alcohol and other pure stimulants produce, and which may terminate in death. But the latter operation has no relation to the medicinal action of narcotics, which is primarily stimulant in every case. It is not even proportioned to this action, for opium, which is the most powerful narcotic, is decidedly less stimulant than belladonna or stramonium, whose hypnotic virtues, on the other hand, are comparatively feeble.

It is unnecessary in this place to describe at length the phenomena produced by narcotic medicines, because they will be fully detailed in connection with the particular articles of the class; but it may be proper to indicate the more striking effects which, in a greater

or less degree, they produce in common. Their primary operation, it has already been stated, is confined to the nervous system, and consists in the diminution or perversion of the sensibility to external impressions and the substitution to a greater or less extent of ideas for sensations. Generally, this state is a pleasurable one, and is accompanied by feelings of nervous tension, followed by a disposition to bodily repose. Opium at this stage of its operation, and indeed subsequently, increases the perspiration, while belladonna and stramonium diminish it. On the other hand, these narcotics and hyoscyamus do not confine the bowels, but rather relax them, while opium tends in a remarkable manner to produce constipation. It restrains the secretion and emission of urine, and, as well as lupulin, displays anaphrodisiac powers. Belladonna, stramonium, and hyoscyamus dilate the pupil, but opium contracts it.

The further operation of narcotics is displayed in the case of lactuca and lupulin, by a calmness which passes into gentle sleep; in that of opium by more or less fulness of the head, somnolence or deep sleep, with heat and moisture of the skin; and in that of the remaining articles by cerebral and arterial excitement, irregular action and diminished power of the muscular system, and more or less delirium, which in some cases is extravagant or furious, and attended with hallucinations. Ultimately, when the narcotic operation is carried to its highest point, it terminates in complete insensibility. It may be produced by all of the articles of this class except lactucarium and lupulin, and is usually accompanied with evidences of cerebral congestion, such as convulsions, and feebleness of the circulation, coldness of the extremities or of the whole surface of the body.

The only medicines of the present class which are known to have caused death are opium, hyoscyamus, belladonna, and stramonium, and the only *post-mortem* lesions attributable to them are congestion of the brain, the spinal marrow, the lungs, heart, and great vessels.

There are very few conditions for the use of narcotics which cannot be fulfilled by opium alone. The principal exceptions to this rule are, the treatment of neuralgic affections and the relaxation of sphincter muscles, in which belladonna and stramonium are more efficient, and the resolution of spasmodic action generally, for which purpose these medicines, and also cannabis, are peculiarly appropriate. The action of hyoscyamus is more nearly allied to that of opium, of which it is a feeble representative and substitute, and from which, as already stated, it differs in relaxing instead of confining the bowels. This, and the two milder articles of the class, are generally employed when opium disagrees with the patient, or when it is intended to exert a soothing influence, rather than to blunt sensibility to pain.

The principal uses of narcotics are to relieve pain and allay irritation. Irritation, in a pathological sense, consists of abnormal movements and relations among the organic elements of a part; pain is the sensation from which a perception of such changes of

condition arises. But irritation may exist without pain. When certain cold-blooded animals are decapitated, irritability of the whole body continues for many hours, and even in warm-blooded animals it does not cease with volition, for, as is now well known, the spinal marrow is a centre which reflects irritations, and converts them into organic or muscular movements which are wholly independent of the will or any other influence of the brain. An analogous condition is observed in man when the spinal marrow is diseased at its upper portion. The most complete disorganization of the parts of the body below the neck may then exist without there being the slightest perception of pain.

Irritation, then, may manifest itself by disordered action with or without pain, and both of these manifestations narcotics have the power to control. It is true that the latter case, or irritation without pain, is one of comparatively rare occurrence; for, although in tetanus and hydrophobia there is pain, the convulsive derangement is disproportionately violent, and in epilepsy no source of local irritation may be discoverable. In the convulsions of infancy and childhood a local irritant is nearly always their cause; it is seated, generally, in some portion of the digestive apparatus, and is connected with dentition, indigestion, worms, constipation, etc., and very often, if not most frequently, occasions no pain.

In all of these cases, except hydrophobia, excessive nervous agitation is appeased by narcotics. Even when the cause of the disorder remains, it acts less violently if the susceptibility of the nervous system is blunted by such medicines, and more time is afforded for the complete removal of the cause, either by the natural progress of molecular action, or through the elimination of a morbid element, by the power of nature alone, or of appropriate medicines. It is perhaps in painful affections that narcotics most strikingly control spasmodic action. Pain, as was before remarked, is a peculiar impression perceived by the brain, and, in general, the nervous derangement which results is proportioned to its severity. It often appears to be the exciting cause of convulsive attacks, but there is much reason to doubt whether it is really so, at least by a direct operation. The spasmodic act is a spinal phenomenon, and is probably excited through the medium of the spinal nerves. Pain, however, augments the susceptibility of the spinal axis, as it does that of every part of the body, by exhausting its power and diminishing its tone. The relations of this great nervous centre to pain are exceedingly curious and interesting, and have not yet been fully explored. Physiology does not explain how impressions from without, or morbid actions within the body itself, excite pain in remote parts. It does not, except by displaying an indirect organic connection through nervous centres between the parts, explain *how*, for example, uterine irritation becomes the exciting cause of toothache, or mammary irritation, during pregnancy; hepatic disease, of pain in the right shoulder; calculus in the kidney or ureter, of pain in the testicles, etc. But these phenomena, and many others that might be adduced, illustrate the mutual relations

of pain and disordered muscular movements, and explain the importance of the part which narcotic medicines play as anodynes.

There are several other modes by which narcotics become remedies for painful diseases, and especially for those which are at the same time inflammatory. In all cases, without exception, of sthenic inflammation in parts supplied with nerves, the first step of the process is pain, and closely upon it follow congestion and effusion. To appease it is to set bounds to them; to neutralize it is often to prevent them. The influence of pain as an exciter of inflammation cannot be doubted, for we have only to remember that the purest form of pain, neuralgia, is often, when very severe, followed by swelling and redness of the parts in which it is seated. Narcotics, then, are antiphlogistic medicines, in so far as they assuage pain, by neutralizing one of the chief agents of irritation, under the operation of which the inflammatory process is developed. Very probably, also, they directly moderate and restrain the organic actions which are concerned in inflammation. This, at least, appears to be the case with opium, which, in full doses, diminishes the activity of vascular movements, and indeed of every function except that of the skin. Hence the supreme excellence of this medicine in so many internal inflammations, and especially of organs which, like the intestinal canal and its investing membrane, have their movements as a whole, as well as their organic molecular actions, restrained by it without prejudice to the general welfare of the economy. Such is the reason of its value in dysentery and in peritonitis, and in those affections and injuries of external parts for the cure of which absolute rest is the most essential condition. It is less efficient in the treatment of inflammatory diseases of the brain and of the thoracic viscera, because the continued activity of these organs is necessary to life, and doses of opium sufficient materially to restrain their action would be inconsistent with the adequate performance of their functions.

The administration of narcotics presents several peculiarities which, indeed, are common to all the agents affecting the nervous system. They operate in smaller doses than any other medicines. In the form of simple extract their ordinary dose is one grain or less, and in that of the alkaloids contained in several of them, a small fraction of a grain. This circumstance should dictate extreme caution in their use. It is further to be observed that their effects vary considerably with the doses, the smaller producing phenomena in which stimulation predominates, the larger those in which narcotic sedation prevails. They also affect very young persons much more intensely than adults, and much more than can be accounted for by a mere difference of age. This fact is doubtless to be explained by the extreme activity and susceptibility of the nervous system in the earlier periods of life, and which has been dwelt upon in another place. It cannot be amiss to recall attention to this fact, an ignorance or a neglect of which has frequently led to the most deplorable results. Finally, all narcotics, and nervine medicines generally, lose their effect by repeated ad-

ministration. In this respect they agree with all agents whatever which act directly upon the nervous system. The habit of using any one of the class must therefore regulate to some extent its dose.

OPIUM.—Opium.

Description.—Opium is the concrete juice of the unripe capsules of *Papaver somniferum.* This is a species of poppy of which there are several varieties. It is a native of Asia, but now grows wild or is cultivated in every part of Europe and the United States. Its culture, for the production of opium, has been chiefly carried on in India, Persia, Egypt, and Turkey in Asia, and of late years also in the South of France. The officinal poppy is an annual plant, five or six feet in height, bearing a large white, grayish, or violet-colored flower, which is usually single, at the summit of a tall, smooth, glaucous stem. The capsule which succeeds the flower is also glaucous when fresh; it forms an elongated or flattened sphere, according to the variety of the plant, measuring from two to four inches in diameter, and is divided internally by radiated membranous septa containing an immense number of minute white or black seeds. These, when ripe, furnish a bland oil, and in Eastern countries, and in Italy, are used for food.

Opium is obtained from the capsules, as soon as their leaves have fallen, by making superficial incisions from which the juice flows and concretes in grains or tears. These are collected and sometimes reduced to a uniform mass by beating, after having been, according to M. Texier, moistened with saliva; but in other cases they undergo no such treatment, and consequently the mass of opium then presents a granular aspect.

As found in commerce, opium of good quality is in hard brownish masses, which grow darker by exposure to the air, and are susceptible of pulverization. It has a peculiar strong odor, and a bitterish and slightly acrid taste. Opium is inflammable, and by burning swells up and is converted into a spongy mass. It is soluble in diluted alcohol and acids. It is a very complex substance: but the proportion of its principal constituents are these: Morphia, 10 to 12 per cent.; narcotin, 6 to 7; codeia, 0.6; thebaina, 1; narceia, 6 to 7; meconin, 0.8; meconic acid, 5; extractive, 25; mucilage, 19, etc. The narcotic virtues of opium appear to depend chiefly upon *morphia*, which exists in it in combination with meconic acid. *Narcotina* is a substance which combines as a base with acids forming bitter salts. It is very inappropriately named, since it manifests scarcely any narcotic action. *Codeia*, like morphia, exists in opium as a meconate. It crystallizes in rhombic prisms and octahedra. *Thebaina*, according to Magendie, is closely analogous to strychnia and brucia in its action upon the system. *Narceia*, narceina, or narcein, forms white, silky, acicular crystals. The other constituents appear to be of inferior consequence.

The officinal preparations which contain opium, or some of its constituents, may be enumerated under the following heads:—

I. Papaver.—*Poppy.*

A *decoction* of poppy-heads, which is no longer officinal, has been used almost exclusively as an external application; it is superseded by solutions of opium.

II. A second class of preparations comprises opium in substance, and its solution in vinous, alcoholic, or acetous menstrua. These constitute by far the largest division of opiate medicines, whether for internal or external use. The following are all which at present are officinal:—

Pilulæ Opii.—*Pills of Opium.*

These pills are made by beating *twenty-four grains* of opium and *six grains* of soap with water so as to form a mass, which is divided into twenty-four pills. Each pill contains, therefore, one grain of opium, whose union with soap renders it more soluble in the gastric juices.

Pilula Saponis Composita.—*Compound Pill of Soap.*

Sixty grains of opium, with *half a troyounce* of soap, are formed into a mass, of which every five grains contain one grain of opium. It has no especial advantage to recommend it. When smaller or larger doses of opium than one grain are required, it seems preferable to direct them extemporaneously. It has been suggested that these pills are convenient to prescribe when the fact that the prescription contains opium is to be concealed from the patient.

Extractum Opii.—*Extract of Opium.*

This preparation is made by intimately mixing *twelve troyounces* of opium with *five pints* of water, and evaporating the filtered liquor to a proper consistence. Of it Dr. Christison remarks: "It is a preparation now but little used, and for which pharmacy is indebted more to prejudice than to scientific investigations." It is, nevertheless, retained in the Pharmacopœia of 1873.

Confectio Opii.—*Confection of Opium.*

This confection is prepared by beating together of opium *two hundred and seventy grains;* aromatic powder *six troyounces;* clarified honey *fourteen troyounces.* It is intended as a substitute for *theriaca*, of which an account is given in the present article, and probably fulfils many of the purposes to which that ancient and multitudinous compound is adapted. Especially is it useful in cases of simple diarrhœa occurring in debilitated constitutions during the heat of summer, and also in cases of feeble digestion, attended with pain and flatulence in persons of a gouty habit. It is chiefly objectionable on account of its bulk when an anodyne operation is intended, since in every thirty-six grains of the mass there is only one grain of the opium.

Trochisci Glycyrrhizæ et Opii. — *Troches of Liquorice and Opium.*

Twenty-four grains of extract of opium, two troyounces of

liquorice, a troyounce of gum Arabic, and three troyounces of sugar, are finely powdered and incorporated with fifteen minims of oil of anise, forming a mass which is divided into four hundred and eighty troches. Each troche will therefore contain one-twentieth of a grain of extract of opium. This preparation is much used for the purpose of allaying irritation of the fauces and air-passages in ordinary catarrh. Its efficacy is much increased by the addition of a small proportion of catechu.

PULVIS IPECACUANHÆ COMPOSITUS.—*Compound Powder of Ipecacuanha; Dover's Powder.*

This valuable preparation is made by rubbing together powdered opium and ipecacuanha, of each *sixty grains*, and sulphate of potassa *a troyounce*. It presents a striking instance of the development of a third power by the association of two others of a different character. The quantity of either active ingredient in an average dose of this powder (ten grains) is too small to develop any marked effects, except perhaps a little drowsiness due to the opium; but the stimulant effect of the latter, associated with the sedative influence of the former, exerts a diaphoretic action, which comes most opportunely into play at the commencement of inflammatory and febrile disorders, and whenever, in their further progress, this action may be appropriate. It is generally inadmissible when nausea or gastric irritation is present. One grain of opium and one of ipecacuanha are contained in ten grains of the powder. The object of the sulphate of potassa is merely to facilitate the subdivision of the other ingredients. Owing to its greater specific gravity, it is said to subside to the bottom of the powder when this is long kept in the same position, so as to render the upper portions of the mass relatively stronger than the lower.

ACETUM OPII.—*Vinegar of Opium; Black Drop.*

The officinal directions for this preparation are as follows: "Take of opium, in moderately coarse powder, *five troyounces;* nutmeg, in moderately coarse powder, *a troyounce;* sugar *eight troyounces;* diluted acetic acid *a sufficient quantity.* Macerate the opium and nutmeg in a pint of diluted acetic acid, for twenty-four hours." By percolation twenty-six fluidounces of liquid are obtained, in which the sugar is dissolved, and sufficient diluted acetic acid is then added to make the whole measure two pints.

Six and a half minims of this preparation are regarded as equivalent to thirteen minims of laudanum or one grain of opium.

The advantages of black drop over opium or laudanum are, that it is less stimulating than either, and less apt than the latter to disagree with the stomach, or affect the nervous system unpleasantly, while its anodyne and soporific effects are equal to those of the other preparations.

TINCTURA OPII.—*Tincture of Opium; Laudanum.*

Two troyounces and a half of powdered opium are macerated for three days in a *pint* of water; a *pint* of alcohol is then added, and after three days longer of maceration, the whole is introduced into

a percolator and diluted alcohol added until *two pints* of tincture are obtained. Thirteen minims of the tincture, or about twenty-five drops, are regarded as equivalent to one grain of opium. This is the most common and largely employed of all the officinal preparations of opium, all of whose virtues it possesses. It is, however, more apt than opium, or than either the vinegar or the acetated tincture, to occasion nausea and headache.

TINCTURA OPII ACETATA.—*Acetated Tincture of Opium.*

This tincture is prepared by rubbing *two troyounces* of powdered opium with *twelve fluidounces* of distilled vinegar, and adding *half a pint* of alcohol. After maceration for seven days, it is expressed, and filtered through paper.

It is thought to be less apt than laudanum to disagree with the stomach, but in this respect it is probably inferior to vinegar of opium. Its dose is ten minims, or about twenty drops.

TINCTURA OPII CAMPHORATA.—*Camphorated Tincture of Opium; Paregoric Elixir.*

"Take of opium dried, and in moderately fine powder, benzoic acid, each *sixty grains;* camphor *forty grains;* oil of anise a *fluidrachm;* clarified honey *two troyounces;* diluted alcohol *two pints.*" These ingredients are mixed, macerated for seven days, and filtered through paper.

The association of camphor with opium and the other stimulants composing this tincture modifies their operation in some degree, and renders it a valuable medicine for the relief of abdominal pains produced by flatus or irritability of the stomach or bowels, and for allaying cough when there is no active inflammation of the pulmonary organs.

One grain of opium is contained in half a fluidounce of the elixir. Its dose for an adult is one or two fluidrachms, and for an infant from five to twenty drops. It is generally administered in sweetened water.

TINCTURA OPII DEODORATA.—*Deodorized Tincture of Opium.*

In this preparation the same proportion of opium is used as in making laudanum. After macerating the opium in water, the resulting liquid is concentrated by evaporation and washed with ether. The supernatant ether is then poured off, and what remains is expelled by evaporation. The residual solution, after being diluted with water and filtered, is mixed with alcohol.

In this process the ether removes the resinous and odorous particles, leaving an aqueous solution of the active principles of opium, to which alcohol is added in sufficient quantity to preserve it.

The strength of this tincture is equal to that of laudanum, but its dose by drops, which are larger than those of laudanum, is less. From ten to fifteen may be given at a dose.

VINUM OPII.—*Wine of Opium; Sydenham's Laudanum.*

Take of opium, in powder, *two troyounces;* cinnamon and cloves, in moderately fine powder, each *sixty grains;* sherry wine *a suffi-*

cient quantity. The powders, mixed, are macerated for seven days with fifteen fluidounces of the wine, and then, by percolation, a pint of filtered liquor is obtained.

Eight minims, or from six to seven drops, of this preparation contain the virtues of one grain of opium. It is, therefore, of nearly double the strength of laudanum. Wine of opium, like the other preparations of this drug with aromatics, is usually acceptable to the stomach, but is less used internally than as an external application in chronic inflammations of the conjunctiva.

EMPLASTRUM OPII.—*Plaster of Opium.*

"Take of extract of opium a *troyounce;* Burgundy pitch *three troyounces;* lead-plaster *twelve troyounces;* water *a sufficient quantity.* Mix the extract with *three fluidounces* of water, and evaporate, by means of a water-bath, to a *fluidounce and a half.* Add this to the Burgundy pitch and lead-plaster, melted together by means of a water-bath, and continue the heat for a short time, stirring constantly, that the moisture may be evaporated."

This is an anodyne and discutient application.

SUPPOSITORIA OPII.—*Suppositories of Opium.*

These suppositories are made with oil of theobroma, and contain each one grain of opium.

III. MORPHIA AND ITS SALTS.

Morphia, the principal narcotic ingredient of opium, is obtained by precipitation with ammonia from a solution of opium in alcohol and water. Morphia is colorless, crystalline, without smell, but very bitter, and is imperfectly soluble even in hot water, but it dissolves readily in boiling alcohol. It is also soluble in fixed and in volatile oils, and in a solution of caustic potassa. It has an alkaline reaction. Owing to its comparatively insoluble character, morphia is seldom prescribed except in combination with an acid.

MORPHIÆ ACETAS.—*Acetate of Morphia.*

This salt is prepared by the direct combination of diluted acetic acid with pure morphia. When pure it forms slender acicular crystals, which dissolve very rapidly in water, but somewhat less so in alcohol. It becomes less soluble by keeping, in consequence of losing a portion of its acetic acid. Its solubility, however, can be readily restored by the addition of vinegar or acetic acid. This salt has a very bitter taste. It is less frequently used than the sulphate for internal administration, but oftener hypodermically, in consequence of its greater solubility. One-fifth of a grain is generally esteemed equivalent to a grain of opium.

MORPHIÆ MURIAS.—*Muriate of Morphia; Hydrochlorate of Morphia.*

This salt is prepared by the direct combination of diluted muriatic acid with morphia. It forms white tufts of radiated acicular crystals. It is very bitter, and is soluble in from sixteen to twenty parts of cold and in eight or ten parts of boiling water. It is also dissolved by alcohol. It is more employed hypodermically than internally. Its dose is the same as that of the acetate.

MORPHIÆ SULPHAS.—*Sulphate of Morphia.*

Sulphate of morphia is obtained by saturating morphia with diluted sulphuric acid. It crystallizes in delicate fasciculi of white acicular crystals of a silky lustre, which undergo no change by exposure to the air, and are intensely bitter. They dissolve in alcohol, in cold water, and in twice their weight of boiling water. The sulphate is the preparation of morphia most usually administered. Its dose, like that of the preceding salt, is one-fifth of a grain.

LIQUOR MORPHIÆ SULPHATIS.—*Solution of Sulphate of Morphia.*

This solution contains one grain of sulphate of morphia to a fluidounce of distilled water. Its dose is a fluidrachm, containing one-eighth of a grain of the sulphate.

SUPPOSITORIÆ MORPHIÆ.—*Suppositories of Morphia.*

Each suppository contains half a grain of sulphate of morphia.

TROCHISCI MORPHIÆ ET IPECACUANHÆ.—*Troches of Morphia and Ipecacuanha.*

Each troche contains one-fortieth of a grain of sulphate of morphia, and one-twelfth of a grain of ipecacuanha, associated with sugar and mucilage.

Medical History.—Opium, from ὀπός, *juice*, is the inspissated juice of the poppy, and is supposed to have received its name in consequence of the valuable properties which rendered it eminently *the juice*, in the same manner as cinchona is now called, simply, *bark*, from its superiority over all other barks. If, however, this etymology of opium is correct, there is a difficulty in accounting for the very slight notice taken of the medicine by the most ancient medical writers. The word opium, indeed, occurs in the Hippocratic books, and is there, as by Celsus, used to denote a narcotic medicine,[1] but is not alluded to as it might be expected a medicine would be which was held in high esteem, or was habitually employed. The first writer to record its remarkable virtues was Dioscorides, who lived in the latter half of the first century of the Christian era. He says: Opium allays pain, induces sleep, promotes menstruation, and is useful in chronic coughs. In overdoses it occasions a deep and terrible lethargy. Externally it is used with oil to allay the pain of headache; introduced into the ear, it relieves earache; a suppository made with it is narcotic.[2] But it does not appear to have been extensively used until physicians of the Arabian school disseminated a knowledge of its qualities. In the writings of one of the most eminent of this school, Avicenna, who flourished at the commencement of the eleventh century, the medicinal applications of opium are shown at length,[3] and their enumeration comprises nearly all of those which are familiar to the practitioner of the present day. This author particularly alludes to its producing derangement of the mind, and of the digestive

[1] ADAMS, Comment. on Paulus Ægineta.
[2] Mat. Med., lib. iv.
[3] ADAMS, Comment. on Paulus Ægineta.

function. Rhazes says that two drachms of opium are a fatal dose; that it produces torpor, and then insensibility, and sometimes general spasms, and that the eyes become hollow, the tongue thick, and the skin is covered with a cold sweat. He adds that the breath of the poisoned person, and also his internal organs, exhale the smell of opium.[1] Under the influence of the Galenical doctrine opium fell into discredit because it was condemned by this hypothesis as being cold, nor was it again received into the confidence of European practitioners until the sixteenth century, when Paracelsus and his successors in the chemical school renewed its vogue.[2] During this and the following age, its reputation increased so much, that Sydenham, when describing the epidemic dysentery of 1669–1672, eulogized this remedy in the most extravagant terms. "Without it," he exclaims, "the healing art would cease to exist, and by its help a skilful physician is enabled to perform cures that seem almost miraculous." Indeed, it was to Sydenham, Morton, Freind, Pringle, and other British physicians that the various modern uses of opium may, in a great degree, be attributed. It is worthy of remark that the application of chemistry to opium has once more, in our own time, extended and facilitated its employment, by extracting from the crude vegetable product the alkaloid bases to which its activity is in a great degree due. *Narcotina* was discovered by Derosne in 1803, and this name applied by him in the erroneous belief that this substance contained the narcotic principle of opium. The chief narcotic element of opium, *morphia*, was first described by Séguin, in 1804, but more perfectly by Setürner in 1817. *Codeia* was isolated by Robiquet in 1832; in the same year *narceia* was discovered by Pelletier, who also isolated *thebaia* or *paramorphia;* and about the same time *meconine* was announced by Coüerbe. *Cryptopia* was described in 1867, by Messrs. Smith, of Edinburgh.

Action. *On Animals.*—The influence of opium and its preparations upon the lower animals differs in a striking manner from that which they exert on man. According to Pereira,[3] a series of experiments instituted by Charvet, in 1826, shows conclusively that the narcotic influence of opium is distinct in proportion to the cerebral development of the animal. In the lower animals, the function of motility is especially affected by opium and its preparations; the invertebrate suffer debility, and paralysis of the contractile tissues, while the vertebrate below the rank of man are chiefly affected with convulsions.

"It is somewhat remarkable," says Pereira, "that the stupor is more manifest in birds than in the lower animals."[4] But this statement is in direct contradiction of many of the experiments of Charvet, upon which he apparently founds it. It is true that Viborg's experiments seem to show a true narcotic action of opium

[1] Ebn Baithar, ed. Sontheimer, i. 64.
[2] Sprengel, Hist. de la Médecine, v. 54.
[3] Materia Medica, Art. Opium.
[4] Ed. 1857, ii. 619.

upon birds. Thus a pigeon, three hours after the administration of *half a drachm* of opium, became torpid and drowsy, then fluttered and cooed, and at the end of ten hours died. So Flourens gave a grain of extract of opium to each of two sparrows, and half as much again to two others; "all four fell into a heavy sleep, with loss of mental and sensory functions." Similar effects were produced in a finch. But a totally different account of the matter is given after certain experiments of Charvet,[1] who found that a pigeon which had taken *six grains* of extract of opium had hurried respiration, vomiting, and purging, and lay quiet, but without any appearance of narcotism, and on the following day appeared to be quite well. He administered to the same pigeon *eighteen grains* of extract of opium, and ligated the bill to prevent vomiting. No sign of narcotism appeared, but the bird breathed very rapidly, and became tetanically rigid, which condition was interrupted by convulsions, in one of which it died about five hours after the opium had been given. Similar symptoms were presented by a feebler pigeon to which *ten grains* of the drug had been administered. Two sparrows, one of which had two and a half grains, and the other five grains of the same drug, died in a similar manner. In other experiments of Charvet, some of the phenomena of narcotism were produced. *Seven grains* of extract of opium were given to a blackbird. In a little more than two hours symptoms of drowsiness appeared, the bird's eyes closed, and his body drooped forward; half an hour later it was so soporose that it would not move without being pushed, and its *breathing was slow.* It died in about eight hours, still comatose, and with only occasional and slight spasms. Very similar, but more strongly marked symptoms, were exhibited by a jay to which the enormous dose of *ten grains* of acetate of morphia had been given. It died in about two hours. On the other hand, a sparrow that had taken *one grain* of acetate of morphia, was affected chiefly with muscular debility, followed by spasms, in which it died. From this narrative it appears, first, that birds will bear enormous doses of opium as compared with those which can be given to man; and, second, that its effects are by no means uniform, since in pigeons and sparrows, as the greater number of experiments testify, the action of the drug is expended upon the spinal marrow, while the functions of the brain remain nearly unimpaired. But in other experiments upon these birds, and upon a blackbird, the narcotic action of opium and of morphia was distinctly exhibited. Yet, on the whole, this operation is the less marked of the two, contrary to what was asserted by Pereira.

In 1868 Dr. S. Weir Mitchell, of Philadelphia, was surprised to find that pigeons appeared to be insusceptible to the narcotic action of opium; for among other experiments he administered to a pigeon twenty-one grains of opium without producing any of the

[1] WIBMER, Wirkung, iv. 105.

common effects of opium poisoning.[1] His suggestion that such facts could hardly have escaped previous notice has above been shown to be well founded. They were equally unknown to other recent experimenters besides himself, among them to Dr. B. W. Richardson, who, by his own observations, fully confirmed Dr. Mitchell's results.[2] Subsequently Dr. M. found that morphia, in the dose of *twelve grains*, might be fatal to one pigeon and not injure another. When morphia was administered hypodermically to pigeons they rarely survived the action of three grains. Observations upon chickens and ducks showed that they are nearly as difficult to poison as pigeons. When to these birds a lethal dose of morphia is given hypodermically, the symptoms are essentially the same as those described by Charvet and others as following a poisonous dose given by the mouth—unsteady movements, partial paralysis, and general convulsions.[3]

Kölliker's experiments upon frogs prove that opium throws these animals into tetanic convulsions, when it is introduced into the stomach or into the spinal canal, and whether the continuity of the brain with the spinal marrow is preserved or not.[4] According to other experimenters, different results are obtained which depend upon the preparation of opium used, and the manner in which it is introduced into the economy. M. Lafargue[5] having observed that the poppy was a favorite food of the rabbit, on which it thrived and grew fat, desired to know whether the animal would be affected by opium. For this purpose, he dissolved three grains of the acetate of morphia in a quantity of water, and mixed the solution with a certain quantity of bran, which a rabbit ate in two days, and was not in the least affected by it. Bouchardat reports that he gave large doses of opium to rabbits with similar results, and states that veterinary surgeons have administered from one to two ounces of opium to horses without producing any bad symptoms.[6] Mulder gave a dog six grains of acetate of morphia dissolved in water; paralysis of the hind legs, salivation, and somnolency with dilated but contractile pupils, followed. On the third day the animal was well. Another dog, which had swallowed six grains of sulphate of morphia, recovered in the same space of time.[7]

In these cases the drug was introduced into the stomach, and there, in all probability, underwent a digestion which robbed it of its poisonous qualities, for we find that when either opium or morphia is more directly absorbed by the bloodvessels, phenomena take place like those alluded to as occurring under the opiate influence in the lower races of animals. Such was the case in Barbier's ex-

[1] Am. Journ. of Med. Sci., Jan. 1869, p. 37.
[2] Br. and For. Med. Chir. Rev., April, 1869, p. 538.
[3] Am. Journ. of Med. Sci., Jan. 1870, p. 17.
[4] Virchow's Archiv, x. 248.
[5] Am. Journ. of Med. Sci., Jan. 1847, p. 223.
[6] Manuel de Matière Médicale, etc., 2ème édition. Paris, 1846.
[7] Bulletin des Sciences Méd., 1827.

periments upon horses, with these substances.[1] Four drachms of the aqueous extract of opium dissolved in water were injected into the trachea of a horse. In eight minutes he reared, then went backwards, at the same time turning round, and raising his feet convulsively. In seven minutes more he was trembling all over, stretching out his neck, jerking his head convulsively, and tottering as he walked. Nine minutes afterwards, on being urged to walk, he fell, and showed no sensibility when rubbed or struck upon the spine. From time to time his head was abruptly raised, his ears lay back, and his eyes winked. Twenty-three minutes afterwards he was again upon his feet, but insecurely, when suddenly he sprang forward and fell. Three hours later he was breathing slowly, and the muscles were contracting spasmodically; the heart beat strongly. He was not comatose, nor even dull, but continued to be convulsed until the expiration of three hours more, when he died. Another horse had about one hundred grains of acetate of morphia dissolved in six ounces of water, thrown into his trachea; he lived three hours, and died in convulsions, after manifesting symptoms almost identical with those in the case just described. The dissection of both these animals showed the cerebro-spinal pia mater to be extremely vascular, and, in the first one, the spinal canal contained a quantity of reddish serum. Albers found that while even thirty grains of opium produced no effect when thrown into a rabbit's stomach, sleep and contracted pupils were the consequences of injecting laudanum into the pleural cavity;[2] and Hunter observed that while the animal was unaffected by morphia introduced into the stomach, it was readily narcotized by the hypodermic injection of morphia.[3] Unless we suppose the destruction of morphia by digestion, these opposite results are quite inexplicable.

Again, we may comprehend why the motor powers should be more excited by an appropriate agent in animals which have the corresponding nervous organs more developed than in man, yet it seems to be reasonable that the organs of the special senses and of the instinctive emotions should be affected, if not in the same degree, at least in the same manner, as in man. The fact of their inferior development ought not, one would suppose, to render them less impressionable to the narcotic influence.

An experiment performed by Charvet proves that the convulsive movements which have been described are due to the influence of the narcotic upon the spinal cord. He found that a lizard affected in this manner by opium continued to be so even after the head was severed from the trunk. A further difference alleged by Bouchardat[4] to exist between the higher and the lower animals relative to the influence of opiates upon them, is that while opium is most powerful in its effects on the cold-blooded tribes, morphia acts with

[1] Matière Médicale, 4ème édition, 1837, v. 18, and 33.
[2] Virchow's Archiv, xxvi. 227. [3] Times and Gaz., March, 1859, p. 235.
[4] Annuaire de Thérapeutique, 1845.

greater energy upon the warm-blooded. He found that fish would die in an hour when placed in water containing one-thousandth part of extract of opium, but would live for three days in water containing a like proportion of morphia.[1]

On Man.—It may be premised that there is very little difference between the action of opium and of its salts upon the human system, and still less depending on the manner of their being introduced, whether this be done by the stomach or rectum, or finally through the skin. It is true that the same individual may be somewhat differently affected by opium and the salts of morphia, but another person may be impressed in a directly converse manner by these two forms of medicine; so that no general rule can be laid down according to which the one should be preferred to the other in a given case. The peculiarities of the patient, as shown by his past experience in the use of opiates, must frequently determine our choice of the preparation to be given, and often the condition of the stomach will suggest the selection of that one which is least bulky, and therefore the least liable to excite nausea or vomiting. But whatever the form of the opiate, or however brought into action, its effects are essentially the same.

In small doses, as from a quarter of a grain to one grain, opium produces upon those who are accustomed to its use a soothing and luxurious calm of mind and body, followed in the course of forty or fifty minutes, by a disposition to sleep, which gradually steals over the senses, and at last wraps the mind in unconsciousness; or, if sleep does not take place, there is a repose of the body undisturbed by pain or external annoyance, and a crowd of dreamy and pleasing thoughts sweep across the field of the imagination. At the same time the pulse, which was at first slightly quickened and more frequent, becomes somewhat slower, the mouth and pharynx are rather dry, and often perspiration breaks out upon the skin. The sleep produced by such a dose of opium may last all night, if the medicine has been taken at bedtime; during the day it will hardly exceed two or three hours in duration.

Larger doses, as from one to three grains of opium, produce much more decided effects. The stage of excitement is much more strongly marked, the head feels full, hot, and sometimes light, buzzing noises are in the ears, the face and eyes are injected, while the pupil is more or less contracted. Flashes of light are apt to appear before the eyes; the ideas are confused and extravagant, and sometimes there is delirium; the pulse is fuller and more frequent; the skin is hot, the mouth and fauces dry; generally there is nausea, and in some cases vomiting. To these symptoms depression succeeds. The pulse beats more slowly, and often irregularly; the head feels heavy and full, and all the senses lose their acuteness; the countenance assumes a stupid, besotted expression, produced by the turgidness of the features, the dulness of the eyes, and the drooping of their lids; there is a strong indisposition to think or

[1] Annuaire, 1846, p. 284.

move, or, more properly, an inability to make any exertion either of mind or body; the speech is thick and hesitating, the muscles of the limbs are affected with spasmodic movements, and if the patient attempts to walk, he feels giddy and oppressed, and staggers like a drunken man. An irresistible propensity to sleep promptly follows these symptoms, and when yielded to the breathing becomes laborious, and often stertorous, while the surface of the body sometimes grows pale and damp, and the hands and feet cold. The sleep may be deep, prolonged, and tranquil, but, produced by the doses mentioned, is much more apt to be disturbed by frightful dreams, from which the patient frequently awakes to relapse immediately into his previous condition. It should be borne in mind that the phenomena now described are those which ordinarily occur in persons who are not distinctly diseased; they are greatly modified by various morbid conditions, and by peculiarities of temperament, age, and other influences which will be mentioned in the sequel.

Narcotism.—Poisonous doses of opium produce effects like those just enumerated, except that they are much more decided, and are not preceded by any distinct stage of excitement. They are thus described by Dr. Beck:[1] "The following symptoms are usually observed within a short time: giddiness, insensibility, and immobility, respiration scarcely perceptible, and a small feeble pulse, which sometimes becomes full and slow. The eyes are shut, the pupils contracted, and the whole expression of the countenance is usually that of deep and perfect repose. As the effects increase, the lethargic state becomes more profound, deglutition is suspended, the breathing is occasionally stertorous, the pupils are insensible to the application of light, the countenance is pale and cadaverous, and the muscles of the limbs and trunk are in a state of relaxation. Vomiting sometimes supervenes, and there is an occasional glimpse of returning animation, but the comatose state soon returns, and death, which is sometimes preceded by convulsions, rapidly follows."

The quantity of opium or of its preparations sufficient to produce all of these results cannot be stated with an approach to accuracy; a few drops of laudanum or a fraction of a grain of morphia may be fatal to young children, and, on the other hand, enormous doses of either have sometimes been taken with only temporary inconvenience. Dr. Beck cites two cases, in one of which twenty-four, and in the other fifty grains of the acetate of morphia were swallowed, without causing death. A gentleman seventy-two years of age recovered from the effects of twelves drachms of laudanum;[2] another, aged thirty-five years, after half an ounce of this preparation had been taken;[3] and a third in which above an ounce was swallowed, and although the symptoms were intense, the patient recovered, temporarily at least, with paralysis of the right side.[4] Another case is reported in which ninety grains of opium were

[1] Med. Jurisprudence, vol. ii. p. 566. [2] Lancet, July, 1857, p. 80.
[3] Boston Med. and Surg. Journ., Aug. 1855, p. 21.
[4] Br. and For. Med.-Chir. Rev., xii. 523.

taken by a female, who got well.[1] An infant of twelve months recovered from the effects of seventy-two drops of laudanum;[2] another, six days old, after taking two grains of powdered opium;[3] and a child not quite six years old, from a dose of seven and a half grains of opium, which were, however, mixed with an equal quantity of prepared chalk.[4] Dr. H. S. Downs reports a case of dysentery in a girl ten years of age, who, in the course of eleven days, took one hundred and forty-eight grains of morphia, besides other preparations of opium. It is stated that on one day twenty-eight grains of morphia were taken, and on another twenty-four.[5] As the patient recovered, it would be satisfactory to be assured that the genuineness of the medicine had been tested. Such examples might be almost indefinitely multiplied.

Mode of Action.—It has always seemed impossible to explain the soporific effects of opium, and most persons have been content to accept the raillery of the French satirist, and admit that opium produces sleep because it possesses a "vis dormitiva." But for this and all specific effects there must unquestionably be a material cause, however recondite it may be, or how difficult soever may be its isolation. Dr. C. Handfield Jones has proposed a very plausible solution of the problem. Guided by the light which physiology has thrown on the functions of the vaso-motor nerves, and by numerous facts which prove that in natural sleep there is less blood in the brain than during waking hours; which also prove that when the cerebral circulation is active sleep is impossible, while it is promoted by everything which tends to diminish the cerebral afflux, as cold to the head, tepid pediluvia, and compression of the carotids; and which further demonstrate that in the fatal sleep produced by extreme cold the brain is often found exsanguious, Dr. Jones concludes that opium causes sleep, in part at least, by its action on the vaso-motor nerves, producing a contraction of the cerebral arteries. The supply of blood being diminished, the functions of the hemispheres are for a time in abeyance. The opposite phenomena produced by belladonna and stramonium, the active congestion of the face and head, and the maniacal delirium they cause, appear to oblige us to assume for their effect upon the brain an opposite physical condition to that produced by opium. Now, we know that they dilate and that opium contracts the arteries, and consequently we have additional ground on which to found the conclusion that the physical cause of natural sleep and of sleep from opium is one and the same. There are, however, two stages of the operation of opium, according to its dose, in which the internal physical effects and the external phenomena are alike different. The one is during the stimulant action of the drug when the face is flushed and there is evidently hyperæmia of the brain,

[1] Am. Journ. Med. Sci., Oct. 1854, p. 385.
[2] Edinb. Med. Journ., iii. 716.
[3] Boston Med. and Surg. Journ., Dec. 1857, p. 357.
[4] Am. Journ. of Med. Sci., April, 1859, p. 367.
[5] Trans. New York State Med. Soc., 1862, p. 249.

and the other when, the specific soporific effects having subsided, either reaction takes place, renewing in some degree the vascular turgor of the head, or else, the nervous power having become exhausted, the blood stagnates in the engorged vessels, and profound coma with stertorous breathing and a turgid countenance indicate the approach of death by compression of the brain. The commencement and the conclusion of the operation of opium in a full dose, are then, it may be concluded, both unlike its action when it produces sleep alone, and hence we may learn why it is so difficult in practice to adjust the dose of the drug so as neither to excite before sleep nor stupefy after it has commenced.

The distinctions between poisoning by opium and other narcotics may here be pointed out. Neither aconite, digitalis, nor tobacco produces stupor, nor does conium, except in very large doses, and that not uniformly. Hyoscyamus, stramonium, and belladonna excite violent delirium, and extreme dilatation of the pupil. Inebriation by alcohol bears a very close resemblance to opiate narcotism in many cases, but the former state is preceded by confusion of ideas or complete delirium, and the breath is strongly tainted with the alcoholic odor.

After death from poisoning by opium, the convolutions of the brain are found to be flattened; the vessels of the cerebro-spinal axis and its investing membranes are gorged with black blood, and the capillaries of the brain give out on incision minute drops of the same fluid. A serous liquid is usually met with in the ventricles of the brain, and under the cerebral face of the arachnoid membrane. The lungs, heart, liver, and spleen are in most cases distended with dark and fluid blood.

Opium Eating.—In some countries where the heat of the climate, or the prohibition of wine by religious enactment, restricts the use of alcoholic drinks, the innate and universal propensity of man to employ some artificial means of promoting the flow of agreeable thoughts, of emboldening the spirit to perform acts of daring, or of steeping in forgetfulness the sense of daily sorrow, has led the inhabitants to seek for those coveted objects in the use of opium. Throughout the whole of Southern Asia, but especially in its most opposite regions, Turkey and China, the consumption of opium for these purposes exclusively is so great as almost to exceed belief. Of late years, also, the habit of chewing opium is alleged to have become very prevalent in the British islands and in the United States, especially since the use of alcoholic drinks has been to so great an extent abandoned by certain classes of people under the influence of the fashion introduced by total abstinence societies, founded upon mere social expediency, and not upon that religious authority which enjoins temperance in all things, in meat and condiments as well as in alcohol and opium. It is true that opium is not likely to become popular among an active and industrious race like the Anglo-Saxon, whose preference must always be for the more potent, though less permanent stimulus, of ardent spirits, the "gross and mortal enjoyments" of which are far more suitable to

the character of that race, than the "divine luxuries" of opium. "If," says De Quincey,[1] "a man 'whose talk is of oxen' should become an opium-eater, the probability is, that (if he is not too dull to dream at all) he will dream about oxen;" but men of active mind and warm imagination, as the Orientals generally are, will choose the stimulant which multiplies and gives a livelier coloring to the ideas, rather than that which, acting more especially upon what is merely sensual in man, excites to muscular exertion and boisterous mirth.

The philosophical but eccentric writer just quoted denies, from his own experience, that opium produces intoxication, declaring its effects to be different from those of wine, not only in degree, but in kind. The excitement produced by the latter is always ascending to a certain point which is soon reached, and then it speedily declines, while that from opium, when once generated, is stationary for eight or ten hours; the former agent disorders the mental faculties, while it stimulates them, but the latter "introduces amongst them the most exquisite order, legislation, and harmony;" the one indeed warms and expands the feelings of the heart, but nearly always gives to an exhibition of them something of a maudlin character; the other promotes benign and charitable sentiments by removing, as it were, the irritation and moroseness which prevented their spontaneous display. Further, the excitement caused by opium is not followed by that depression and general derangement of the system which succeed excess in wine. The mischiefs entailed by the habitual abuse of these two stimulants are also different. Alcoholic drinks more commonly tend to bloat and swell the body, giving to the flesh a dull and sodden look, but without altering the color of the skin further than by producing red eruptions upon the face and a purplish complexion; long indulgence in opiates, on the contrary, renders the frame more attenuated, gives the flesh a dry and shrunken look, and to the complexion a dusky hue approaching to yellowishness. The former reduces the mind to a state of childish and pitiful imbecility; the latter renders it sluggish and torpid, chaining it down in sloth, but without wholly destroying its consciousness of power.

The kind and degree of ill health produced by opium-eating are not well ascertained. We have more knowledge of the sufferings produced by an attempt to renounce the use of this drug, and which all witnesses concur in representing as intolerable agony. Besides being tormented by a perfect chaos and conflict of ideas of the most distressing nature, the miserable victim is a prey to perpetual terror, and feels in his stomach an urgent craving for a fresh supply of the now necessary stimulus, which has been often, and no doubt truly, compared to the literal gnawings of a ravenous animal. Against such demands few persons have the energy to struggle effectually, and their best success is apt to be nothing more than a power to refrain from increasing the dose, or at most to diminish

[1] Confessions of an English Opium-Eater.

it in some degree. The difficulty of renouncing the baneful habit of opium intoxication, or even of approaching its renunciation, may be conjectured from the enormous quantities of the drug habitually consumed by its votaries. De Quincey states that he frequently took as much as 8000 drops of laudanum a day, or its equivalent, about 320 grains of opium. It is alleged that Coleridge could with impunity take double that quantity. Many cases are recorded in which from one to two drachms were daily consumed; and Dr. Chapman relates[1] that, in a case of cancer of the uterus, the quantity was gradually increased to three pints of laudanum, besides a considerable quantity of opium, in the same period.

Although it is probably true that a large majority of those who are addicted to the intemperate use of opium lose their health, and prematurely die, yet it should be known to physicians that the vice does not always entail such serious consequences. In Haller's Dissertations, it is recorded of a woman that from the age of puberty to beyond that of the menopause her daily dose of opium was from one to four drachms.[2] In connection with the case just alluded to, Dr. Chapman mentions another, of which he says: "I knew myself a wineglassful of laudanum to be given several times in twenty-four hours for many months in succession, to alleviate pain from the passage of biliary calculi, and the patient finally recovered, without suffering from this excessive use of the article." Dr. Harrison, of Cincinnati, presents the following extraordinary case:[3] "A young lady of this city has for years, until lately, been in the habit of taking between five and six hundred grains of opium a day, and now can never do with less than seventeen grains of sulphate of morphia each day. The only disease she labors under is irregularity of the uterine function, accompanied by hysteria of the most strongly expressed character." Dr. Christison[4] was probably the first person to bring together any number of instances to illustrate the bearing of opium intemperance upon longevity. The paper referred to in the note contains ten authentic examples of persons who were for years in the habit of taking opium or laudanum every day in various quantities, the least of which would have been sufficient to kill one unaccustomed to this narcotic, and who, nevertheless, did not appear to have life shortened or health materially impaired by such excesses. A proof of the little injury produced in these cases is the fact that in several of them the habit of opium-eating was not suspected to exist; in others it may be added there was entire absence of constipation, a symptom, perhaps, the most unfailing of all which opium in small doses gives rise to. A remarkable instance of the tolerance of large doses of this narcotic is related by Mr. Whalley.[5] A woman about thirty years of age fell into the habit of laudanum drinking from having first used the medicine as an anodyne, and continued it for more than fourteen

[1] Elements of Therapeutics, 4th ed., ii. 200. [2] Vol. viii. p. 303.
[3] Elements of Materia Medica and Therapeutics, ii. 554.
[4] Edinb. Med. and Surg. Journ., Sept. and Oct. 1831.
[5] Lancet, July, 1866, p. 35.

years. "After the lapse of a few years she was capable of taking a quart a week. More than this the stomach would not tolerate. Its effects upon her spirits were most exhilarating. She felt lively and cheerful, and could accomplish any amount of household work; and instead of suffering from constipated bowels, with accompanying headache, they were invariably relaxed, and there was entire freedom from headache. She slept well, her appetite was good; in fact there was very little if any disorder of the digestive organs. The organs of sense did not exhibit any signs of impairment, except that of sight, which was not quite so good as formerly. If deprived of the laudanum for a single day, the most unpleasant symptoms came on; loss of sleep and appetite, and an indescribable feeling of languor, with a corresponding depression of spirits, and slight involuntary motions of the limbs, all of which were readily relieved by the accustomed dose of laudanum." A case is mentioned[1] of a literary gentleman who had been long in the habit of chewing opium, and who for the last two years had consumed about one hundred and fifty grains a day. Its only injurious effect was to produce impotence. It is due to Dr. Christison to state that he did not conclude, from the cases referred to above, that the use of opium was not destructive to health; on the contrary, he distinctly declares his belief "that this habit will be eventually found not less destructive than the vice of drinking spirits." As yet, however, the proof has not been furnished.

Opium Smoking.—This mode of obtaining the beatifying effects of opium does not appear to have been much in vogue except amongst the Chinese, although it is said[2] that a party of Parisians, with the characteristic eagerness of the French for novel sensations, formed some years ago a club for smoking opium, each of the members of which was obliged to record in its journal the results of his experience.

According to Dr. McPherson,[3] one of the latest writers upon the subject, opium is never used by the Chinese in its crude state, but undergoes an imperfect purification, which vastly increases the strength of the residuum. When used for smoking, it has the appearance and consistence of tar. A piece of this substance about as big as a pea is partially roasted at the flame of a lamp until it is reduced to a proper degree of inflammability, when it is set on fire in the bowl of a peculiarly constructed pipe, and its smoke drawn with one long deep inspiration into the lungs, which have previously been emptied as much as possible of atmospheric air. In this single whiff the opium is almost entirely dissipated. The fumes are retained a short time in the lungs, and then emitted through the nostrils, or, as by our own more dextrous smokers of tobacco, through the ears also. This operation is repeated until the effects of the drug are felt, a period which varies according to the susceptibility of the individual.

[1] Bull. de Thér., xiv. 64. [2] BOUCHARDAT, Annuaire de Thérap., 1842.
[3] "Two Years in China," quoted in BELL'S Bull. of Med. Sci., 1843, p. 111.

The effects of the opiate fumes when thus inhaled are said to be far more exhilarating and immediate, as well as more transient, than when opium is taken into the stomach. "The pulse," says the writer above alluded to, "vibrates, it becomes fuller and firmer; the face glows, the eyes sparkle, the temperature of the skin is elevated, and it becomes suffused with a blush; the organs of sense are exquisitely sensitive, perspiration flows profusely, respiration becomes quicker, the action of the heart is increased, the nervous energy is exalted, and a glow of warmth, and sensations similar to those which often attend highly pleasureable and agreeable feelings, overspread the body." The mind shares in the general exhilaration, and is filled with those delicious and brilliant ideas which follow the other modes of employing opium; but if the smoking is too long protracted, these pleasing feelings vanish; "all control of the will, the functions of sensation and volition, as well as reason, are suspended; vertigo, coma, irregular muscular contractions, and sometimes temporary insanity supervene."

Mr. R. Little has described the mode of smoking opium in Hindostan in terms nearly the same as those which we have quoted from Dr. McPherson, adding that, after the effect of the stimulant has passed off, a state of languor, listlessness, and incapability of exertion succeeds, together with loathing of food, nervousness, aching of the limbs, gloom, and undefinable wretchedness, a state from which the smoker has no relief until the period comes round for renewed indulgence in the gratification which led to it, and which again infallibly induces it."[1]

Dr. McPherson testifies to the comparative harmlessness of opium-smoking when not carried to an extravagant degree. "Were we," he remarks, "to be led away by the popular opinion that the habitual use of opium injures the health and shortens life, we should expect to find the Chinese a shrivelled, and emaciated, and idiotic race. On the contrary, although the habit of opium-smoking is universal amongst the rich and poor, we find them to be a powerful, muscular, and athletic people, and the lower orders more intelligent, and far superior in mental acquirements to those of corresponding rank in our own country. The Chinese themselves affirm that the use of the drug acts as a preventive against disease; and in this opinion, when smoked in moderation, I am inclined in part to agree with them. . . . . Its effects, certainly, are not so disgusting to the beholder as those of alcohol on the sottish, slavish drunkard." The opinion of the Chinese respecting opium is very much like that of many in our country regarding tobacco, and proves that it would be as unfair to deduce the effects of opium-eating or opium-smoking from those produced by the drug in medicinal doses upon persons unaccustomed to its use, as it would to expect, from the habit of chewing or smoking tobacco, the violent and even poisonous effects which it sometimes produces when administered by the rectum in cases of strangulated hernia, or when

[1] Monthly Journ. of Med. Sci., June, 1850, p. 524.

first ventured upon by lads who imagine that it is manly to ape the vices of men.

Lest we should be suspected of a design to palliate the evils of using opium as an habitual stimulant, we refer again to the paper of Mr. R. Little regarding the effects of this vice, as he observed them in Singapore. After referring to the conclusions of Dr. Burnes from observation at the court of Lahore, and to those of Dr. McPherson which we have just quoted, Mr. Little draws a frightful picture of the derangement of the nervous system, and of the digestion, the oppressed breathing, and hazy, bleared eyes of the devotees of this vice. The sexual organs lose their power, and are affected with a gleety discharge, the flesh withers, and the bones are racked with pains. The stooping figure, shuffling gait, drooping eyebrow, and dull eye surrounded by a livid circle, give an appearance of premature decrepitude. In both sexes the procreative power is lessened, and in females the secretion of milk is defective. Ultimately the stomach is the seat of an incessant gnawing pain, the food is vomited, diarrhœa comes on, the urine is turbid, and Bright's disease is not uncommon. Dr. Libermann, who was a medical officer at the invasion of Pekin by the English and French, has furnished a picture of the effects of this vice, which corresponds exactly to what has now been presented; but he adds some touches which were wanting to complete it, by describing the state of chronic delirium into which the opium-smoker ultimately falls. The wretched man is assailed by the most various hallucinations, but all very unlike the voluptuous visions which he enjoyed on his first dalliance with the poison. The most disgusting objects and the most horrible scenes are perpetually before him, but most of all at night, when he in vain seeks refuge from his misery in sleep. He is haunted by spectral toads and all manner of obscene animals, or a fiery dragon swoops around and drags him into a flaming pit. Sometimes he endures all the tortures of the Buddhist hell; or, fancying himself one moment in voluptuous embraces, the next he finds within his arms the mangled limbs of a hideous monster. These images, which, we are assured, are literal copies of the opium-eater's phantasms, present a vivid resemblance to the more familiar spectral illusions of delirium tremens.[1]

Action of Opium upon particular Organs.—It is unnecessary to repeat here what has been stated in the preceding remarks regarding the action of opium upon the *nervous system;* it affects this system primarily and chiefly, and all of its functions without exception, first exalting their activity beyond the standard of health, and rendering the communication with the external world more perfect and intimate; then creating an internal world of new, and, for the most part, of grateful perceptions; and at last drawing, as it were, the curtain over all real as well as fancied forms, produces complete unconsciousness.

On the Pupil.—The power of opium to produce contraction of the

[1] Archives Gén., Fev. 1863, p. 246.

pupil has long been known, and used more or less intelligently as a guide in the administration of that drug. Physiology now claims to explain this curious phenomenon, having shown that division of the third nerve causes dilatation, and section of the sympathetic nerve contraction of the pupil. Of the two influences which are normally balanced, either may preponderate. Opium is a sedative of the sympathetic system, and during its action the capillaries are relaxed, the iris becomes turgid, and the pupil is contracted; belladonna is a stimulant of the same system causing contraction of the bloodvessels of the iris, lessening the turgor of the organ, and thereby causing the pupil to dilate.

On the Organs of Digestion.—The influence of the occasional use of opium upon the appetite is very striking; it almost entirely destroys the cravings of hunger, and when it disposes to sleep, and during its narcotic influence, it inspires disgust for food. The power which opium has of repressing the appetite is effectually made use of by the Tartar couriers, who in their long and rapid journeys have no time to stop for refreshment. The habitual use of opium, however, seems to annul this effect; the stomach becomes tolerant of the stimulus, and learns to perform its function with considerable regularity; but when the usual quantity of the drug is much diminished, indigestion comes on, with that horrible craving before alluded to, which will not be pacified by food, but only by an increased dose of opium.

While opium diminishes the appetite for food, it augments the thirst, adding another to previous proofs that these sensations depend upon different causes. It is supposed by many that hunger is produced by the peristaltic movements of the empty stomach, causing attrition of the opposite faces of its lining membrane; on this supposition opium, by arresting these movements, and at the same time blunting the sensibility of the gastric nerves, would suspend or mask the sensation. Thirst, on the other hand, seems to be excited by dryness of the mucous membrane of the stomach, and, as we shall see, opium diminishes all of the internal secretions; a sense of dryness in the mouth and throat is indeed one of its first and most ordinary effects. Hence, we may plausibly explain why opium at the same time appeases hunger and excites thirst. It may be added that these effects cannot be due to any merely topical action of opium in the stomach, because they occur with equal uniformity whether the opium be swallowed, or its salts be introduced through the skin.

Not only do opiates when first administered destroy the appetite, they also embarrass or suspend altogether the digestive process; the food which is taken while the system continues under their influence remains undigested, as is proved by the fact of its being subsequently rejected without having undergone any alteration; or, if the opiate is administered during the first stage of digestion, the subsequent assimilation of the food is retarded or prevented. MM. Trousseau and Pidoux hence derive their caution not to place a

patient under the influence of this drug while his stomach contains food, or immediately before eating.[1]

The insensibility of the stomach to other stimuli, produced by opium, is perfectly analogous to that noticed in the case of food. It is a familiar fact that larger doses of emetics are required to produce vomiting in persons under its influence than either before or after its action, and this circumstance has a valuable application in the treatment of narcotic poisoning in which considerable quantities of the most active emetics often fail entirely to evacuate the noxious substance.

Opium, however introduced into the system, is very apt to occasion nausea or vomiting. The writers last quoted have noticed two varieties in the mode of production of the latter symptom. When the salts of morphia are applied hypodermically for several successive days, they excite vomiting during the first two or three days, and afterwards occasion only nausea; but when taken internally, vomiting does not take place during the first few days, but then commences, and continues during the subsequent administration of the drug. In either case, it occurs much less frequently in males than in females, and particularly in those of a nervous temperament. It is not to be supposed, however, that this symptom is at all of uniform occurrence; nausea, on the other hand, affects nearly all who use the preparations of opium medicinally, and with the peculiarities mentioned in regard to vomiting.

The paralyzing powers of opium are not less evident in its effects upon the bowels. Constipation almost invariably follows its medicinal employment, at least during the earlier periods of its administration; after its protracted use this symptom gradually yields. This has been observed in the opiate treatment of acute rheumatism by Drs. Corrigan, Stokes, and others. We once treated a case of this disease in which the patient, after three or four days, took a grain of opium every hour; by that time it ceased to confine his bowels, which continued to be moved regularly every day. The suspension of the alvine secretions by opium, as well as the torpor of the intestinal muscles, doubtless contributes to promote constipation. It is probable, also, that, as observed by Sproegel,[2] the diminished secretion of bile may contribute to this effect; not merely that the liver fails in its function, but also that the movements of the gall-ducts and of the duodenum, which solicit the discharge of bile, become sluggish and feeble.

It has been found that *morphia*, used by the hypodermic method, uniformly produces constipation alone, while the same agent, given internally, confines the bowels during a few days only, and then, in some instances, occasions diarrhœa.

On the Circulation.—The manner in which the movements of the heart are affected by opium is very far from being uniform. "Some writers," says Barbier,[3] "will have it that opium stimulates the

[1] Traité de Thérapeutique et de Matière Médicale, 5ème éd., vol. ii. p. 15.
[2] Quoted by PEREIRA, op. cit., art. Opium. [3] Op. cit., tom. iii. 51.

heart, and makes the pulse more frequent, while others maintain that it enfeebles the vitality of this organ, and renders its contractions slower; on the one hand, it is believed that the narcotic extract gives volume and resistance to the pulse, while, on the other, it has been observed to grow smaller and more corded under the influence of opium. Do not such opposite opinions about phenomena so easily ascertained prove that the action of the substance in question upon the circulatory apparatus is in reality complex and variable?" The correctness of this conclusion cannot be questioned. As a general rule, a full dose of opium renders the action of the heart stronger and more frequent in the first instance, while the skin becomes turgid and red; subsequently, however, it reduces the frequency without diminishing the volume of the pulse. If, on the other hand, the person taking opium has that morbid susceptibility to its influence which is shown by its affecting the stomach more than the brain, and is nauseated or made to vomit, the pulse will be found irregular and feeble, and perhaps small. Or, again, if the drug be given in a poisonous dose, its first, or stimulant influence on the circulation will be but momentary, its depressing powers will be more plainly shown, and, after a time, as coma and asphyxia approach, the pulse will be found small, weak, and irregular, qualities which it doubtless owes to the debility affecting the heart in common with all the other muscles, whether of organic or animal life.

On Respiration.—Opium influences the breathing precisely as it does the circulation; or it would be more proper to say that these two functions are simultaneously affected, and the disturbance of each interrupts the other. It is perhaps not possible to decide whether the excitement of the circulation is directly due to an augmented influx of nervous power, whether it is produced by the increased action of the lungs, which takes place simultaneously, or whether, on the other hand, the activity of the respiratory movements is a secondary phenomenon, dependent on the greater amount of blood thrown into the pulmonary vessels. Nor is the question one of great importance, for we know that, as just stated, both functions simultaneously experience an increased activity. Respiration, however, becomes remarkably slow as the narcotic effects of opium are developed, and in cases of narcotic poisoning is indeed scarcely perceptible. On this account the blood which returns from the lungs to the heart has undergone a very partial revival, but yet continues to circulate. Every moment, however, the proportion of oxygenated blood in the circulating mass grows less and less, until it reaches a point of impurity which deprives it of its power of stimulating the organs to perform their vital acts, and death soon takes place. This explains why the blood of those who have perished by narcotic poisoning is so intensely black, and why, also, the most direct remedy for narcotic asphyxia is the introduction of oxygen into the lungs by artificial respiration.

On the Urinary Apparatus.—Observers differ materially in regard to the effects of opium on the secretion of urine. Experiments upon

quadrupeds would at first sight appear to show that the function of the kidneys is diminished, for Sproegel, Charvet,[1] and others found that animals to which opium had been given did not pass urine, in some cases, for several days; but it also appears from these experiments that the kidneys did not cease to secrete, although the bladder failed to discharge, urine. MM. Trousseau and Pidoux are the only writers who appear to have studied with care the influence of opiate preparations upon the secretion of urine. It results from their observations that it is more frequently diminished than increased, but that, in general, the use of an opiate, in pretty full dose (as one or two grains of a salt of morphia in twenty-four hours), must be continued for at least two days in order to produce either effect. The authors in question report that, in five cases of retention of urine caused by opiates, and in which no urine had been passed for one or two days, not more than six or eight ounces of liquid were drawn off when the catheter was used. It is certain, however, that morphia sometimes increases the amount of urine discharged, while its density is diminished. We have never known this effect to follow the use of opium. A ready explanation of the diminished secretion of urine under the influence of opium is found in the copious discharge of fluid from the skin, which, as will presently be shown, takes place from the same cause. Next to the bowels, the skin and the kidneys are the two great emunctories of the system, the former being most active in warm, and the latter in cold climates or seasons, and the one serving as an alternate to the other. Unless, from some morbid cause, there is an excess of fluid in the body, activity of one of these organs indicates that the other is in repose.

The retention of urine produced by opiate medicines has been variously explained. According to some, it depends upon the small quantity of urine secreted; but more than enough is usually contained in the bladder to excite its contraction, were not this prevented by some other influence. The power of opium to paralyze the muscles and blunt sensibility, as already pointed out in the case of the digestive organs, is quite sufficient to account for the phenomenon under notice. If it is objected that the urine is not, as in cases of paraplegic paralysis, discharged involuntarily, a sufficient answer is that the quantity collected in the bladder is at no time very large, except in very rare cases, in some of which, indeed, the urine drips away without the patient's consciousness.

MM. Trousseau and Pidoux have pointed out another cause of difficult urination arising from opiates, to which they attach a paramount importance, the diminution, namely, of the mucus which lubricates and protects the lining membrane of the bladder. Doubtless this membrane, like the mucous coat of the mouth, pharynx, and digestive canal, ceases to secrete mucus in due proportion when the system is affected by opium; to this cause we may fairly attribute the strangury which often attends the efforts to

[1] Quoted by PEREIRA, op. cit.

pass water, for the sphincter vesicæ is in all probability irritated to spasmodic contraction; but it does not appear to form a sufficient cause for simple retention of urine without strangury.

On the Organs of Generation.—Opium is generally reputed to have the power of exciting the venereal propensity; but, as Cabanis well observes, it owes this reputation rather to its common stimulating properties than to any specific action, and renders more intense the feelings which happen to be indulged in during its influence. Wedel, who maintains its aphrodisiac virtues, expressly states that they are manifested *in calidioribus, præcipue vero dispositis.*[1] The Sultan, upon his luxurious couch, is just as naturally inspired with sensual longings by the fumes of opium as the janissary or the spahi in battle is urged by them to deeds of blood and carnage. The fact that in the bodies of those who have died while under the influence of opium the penis has sometimes been found in a state of erection, proves nothing in favor of the specific aphrodisiac powers of this drug, but only shows such cases to be analogous to those of death by hanging, and other instances of cerebral congestion, in which a like phenomenon has been observed. It is stated by Dr. Woodward, of Galesburg, Ill., that he has seen opium used, and also employed it, efficiently, to blunt the sexual desire. The long-continued abuse of it much more certainly induces impotence; yet not by a direct organic action so much as by involving the whole system in debility. The menstrual discharge is sometimes augmented by opiates. MM. Trousseau and Pidoux relate that in eight cases, under an opiate treatment, they observed either this increase, or the premature occurrence of the menstrual period, or else the return of the flow after it had been for some time suspended. The particulars of these cases are not, however, given; but, as they were treated in a hospital, it is probable that they were of diseases whose nature or progress was not wholly without influence on the condition of the menses. Dr. James M. Smith, of New York, has published several cases which appear to show, on the other hand, that the use of opium, in excessive quantities at least, tends to suspend the menstrual function.[2]

Dr. P. C. Barker, Morristown, New Jersey, claims for opium a special power as a parturient agent, in those cases in which the circular fibres are alone called into action while the longitudinal and oblique fibres contract irregularly, *i. e.*, in "false pains." He believes that opium possesses the power "of relaxing the circular fibres, at least of the os, and of stimulating the longitudinal and oblique fibres into active contraction."[3] A more simple and intelligible rationale would seem to be that the relaxation of the os uteri produced by the opium permits the body of the organ to assume its natural rhythmical contractions.

On the Skin.—Nothing is better established than the power of opium to excite perspiration. This property of the drug was well

[1] HOFFMANN, Opera Omn., v. 81.
[2] N. Y. Journ. of Med., ii. 56.
[3] New York Med. Journ., ix. 261.

known to the older writers. Bonetus[1] says "we have hardly any diaphoretic so faithful, so certain, or which so well deserves the name;" and Cullen[2] declares that "at all times opium has been found to be the most effectual of all sudorifics." Many of the old stimulant diaphoretics owed their activity entirely to the opium contained in them. Cases of poisoning by this agent strikingly illustrate its sudorific powers, for in most of them the skin is bathed in a profuse, and sometimes greasy and graveolent, sweat, while its temperature continues at the natural standard, or is even above it. It is said that, when the salts of morphia are employed hypodermically, the perspiration breaks out first in the neighborhood of the part in which the inoculation is made, and thence extends to the entire surface.[3] It is usually, however, most copious upon the face and breast. The heat of the skin is meanwhile increased, and remains so as long as the sweat continues, which is ordinarily for twenty-four hours. The manner of introducing morphia into the system does not modify the effects in question, except that their appearance is hastened when the hypodermic method is employed. The diaphoretic influence of opium is much more distinctly exhibited in females than in males. A very common effect of opiate medicines, and, if we are not mistaken, of the salts of morphia especially, is an intolerable itching of the skin; so intense is the irritation arising from this cause in some instances, that the anodyne and composing influence of the drug is entirely annulled, and the patient tosses about the bed, unable to find comfort in any position, and rubs or scratches every part of the body with violence. This itching is quite independent of the cutaneous eruptions which opiates frequently occasion, and which usually consist of slightly elevated and reddish patches resembling those of measles,[4] or are still more prominent, like the wheals of urticaria. The latter, as well as prurigo and eczema, are not unfrequently developed around the margin of the blistered surface upon which a salt of morphia has been sprinkled, and give rise to a very annoying degree of itching. In a case in which the eruptions just mentioned appeared on taking even the smallest dose of opium, there was at the same time an almost complete loss of sight and hearing.[5]

The Internal and External Use of Opiates Compared.—MM. Trousseau and Pidoux are, so far as we know, the only persons who have made this comparison experimentally. For this purpose they selected persons as nearly as possible in similar circumstances, and administered to each from one to two grains of morphia endermically, or by the stomach. In the former case, thirst, vomiting, drowsiness, heaviness, and disturbance of the sight followed almost instantaneously; in some, these symptoms began to appear within two minutes after the morphia was applied to the denuded skin. In the latter, they did not arise in less than from one to three hours, and in most instances vomiting did not occur for several

[1] The Practical Physician's Guide; translated from the Latin. London, 1684.
[2] Materia Medica, art. Opium.
[3] Trousseau and Pidoux.
[4] Duclos, Annuaire de Thérap., 1847.
[5] Dublin Med. Press, April, 1863.

days. These experiments, whether performed upon different persons or successively upon the same, furnished identical results, and show either that cutaneous is more rapid than gastric absorption, or that the stomach assimilates or in some other way neutralizes a portion of the morphia received into it. They also prove that nausea and vomiting, when produced by opiates, are not owing to the direct action of these medicines upon the stomach, but to an indirect influence exerted by them through the brain, since the cerebral symptoms uniformly precede the gastric disorder.

Although the prompt and efficient action of opiates on the system ought not to be expected from their external application unless the cuticle is first removed or penetrated, yet it cannot be questioned that they may be partially absorbed even through the unbroken cuticle, and, in some exceptional cases, produce distinctly poisonous effects. No fact is more familiar than the relief obtained by simply bathing a painful part with laudanum, or applying to it an opiate fomentation. The following case proves that even this method is not always unattended with risk: A young man was directed by his father, who was a physician, to apply a poultice sprinkled with a few drops of wine of opium to the pit of the stomach, for some slight ailment under which he was suffering. As the pain was rather acute, the patient determined to allay it by employing a larger dose than had been ordered, and accordingly emptied upon the poultice the whole contents of the vial, after which he went to sleep. Symptoms of narcotism soon appeared, and although the usual means were employed to combat them, it was in vain, and the patient died.[1]

In the experiments above referred to, the effects produced by opium were the same for equal doses applied to the denuded skin and introduced into the stomach. This substance administered by the rectum occasions the same train of symptoms, but not in a like degree of intensity for the same dose. Whether the dose requisite for producing through the rectum an impression equal to that caused by the ordinary quantities employed in the other two modes, should be greater or less than these, is still an unsettled question. Orfila asserts that opium is more active when given by the rectum than by the stomach, assigning as a reason for this statement the greater venous absorption and the inferior digestive power of the former. It is perhaps not surprising that this distinguished writer, who was not a practitioner, should have expressed an opinion founded on physiological data alone, but it is repeated by the authors last quoted as the result of actual experience. "We know," say they, "that medicinal agents given by enema operate more actively than through the stomach, provided they are retained equally long in both cases."[2] Dr. A. T. Thomson remarks that opium "acts, if not as powerfully, at least as rapidly, when thrown into the rectum as when taken into the stomach."[3] On the other hand, Pereira

[1] Bouchardat, Manuel cit., p. 40. [2] Art. cit.
[3] Elem. of Mat. Med. and Therap., 2d ed., p. 414.

says: "Whenever I have had occasion to employ opium by way of enema, I always exhibit twice or three times the ordinary dose without exciting any remarkable effects." Cullen considered twice the ordinary dose by the mouth as proper to be given by the rectum. The statements of these English writers agree perfectly with opinion and usage in this country, and we are unable to account for so opposite a view, on the part of such eminent and accurate observers as MM. Trousseau and Pidoux, in regard to a subject of daily experience. It is probable, however, that one source of the discrepancy of opinion here alluded to is the fact that opium administered by the rectum sometimes finds that bowel empty, sometimes filled with fæces, is sometimes entirely retained, and on other occasions partially or wholly expelled. It is evident that no uniform result can be expected under such various conditions.

Modus Operandi of Opium.—Until the nervous system was made to play a prominent part in pathology by the exclusive theories of Van Helmont and Hoffmann, the effects of opium were universally attributed to the absorption of its particles, or at least of its essence, into the blood, and its direct action upon the brain. During the greater part of the last century and a half, however, a different notion prevailed. "Opium," says Van Swieten, "does not act by dissolving and mixing with the humors, so as to pass by the laws of circulation to the brain; but by remaining in contact with the internal face of the stomach, it produces such a change in the nerves there distributed as blunts the perceptive faculty of the brain."[1] Modern experiments, and a careful analysis of the effects of opium, have gone far to overthrow the later theory, and it is now very generally admitted, that, although this agent when applied directly to the nervous extremities may produce a local loss of sensibility, its general or constitutional symptoms are entirely due to the vascular absorption of its narcotic principles.

The most important of the considerations which sustain this view are the following: Some time elapses between the application of an opiate to a mucous surface, or to the denuded skin, before narcotic symptoms make their appearance. The interval is shortest when the preparation used is most soluble. The effects of an old opium pill are much slower in appearing than those of laudanum or a solution of morphia. On the other hand, narcotism is more speedily produced by the injection of an opiate into the veins than by any other mode whatever. When a person has swallowed a poisonous dose of laudanum, its effects continue for some time after the complete evacuation and cleansing of the stomach, proving that a portion of the drug has been absorbed, and continues to act upon the nervous system; and, on the other hand, if the laudanum is allowed to remain, the symptoms go on increasing, although the noxious agent is as completely in contact with the gastric mucous membrane during the first as at any subsequent period of its operation. Again: The symptoms of narcotism are chiefly cerebral.

[1] Commentaries on BOERHAAVE, § 229.

Now there is no direct connection between an impression made upon a nervous extremity and the brain, unless that impression be also a sensation. In other words, if the direct action of the opiate were limited to the nervous extremities, with which it is in contact, its remote effects should be displayed only in distant parts dependent upon the central ganglia of the cerebro-spinal system: but such is not the case; the immediate effects are observed almost exclusively in the organs of thought, while those of a more secondary character are displayed in parts supposed to be particularly under the control of the ganglionic and spinal systems.

Besides these reasons in favor of the absorption of the active principles of opium, which, it will be observed, do no more than render it the more probable of the two theories under consideration, others remain which have the force of direct demonstration. There is in reality no greater barrier between an opiate in the stomach, and the bloodvessels, than there is between it and the ultimate branches of the nerves. A membrane intervenes which the opiate must traverse in order to reach either. It is the passage through this membrane which constitutes absorption, so that the act takes place whether the medicine be supposed to stop at the nerves or to mingle with the blood. To deny that it takes the latter course involves, consequently, a gratuitous assumption.

But, finally, and this constitutes a sufficient and unanswerable argument, the secretions of a person under the influence of opium possess the qualities of the drug. Its odor is readily detected upon the breath of those who habitually use it, as well as in their urine and perspiration, when large quantities have been taken. "I have seen," says Barbier, "a child remain for several hours in a state of narcotism after having taken the breast of a nurse who, a short time before, had swallowed a large dose of wine of opium to relieve cramp in the stomach."[1] The active principles of opium being absorbed into the system, they are presumed to act upon the nervous system, because the phenomena to which they give rise are clearly of nervous origin; but the manner in which these effects are brought about is altogether unknown, and cannot be even plausibly conjectured. Like all that relates to the intimate nature of nervous function, it is a vital act, not cognizable by the senses, and therefore constituting no part of human knowledge.

Many and acrimonious disputes have been held as to whether opium is a stimulant or a sedative. About as profitable was the more ancient discussion whether opium is hot or cold, and which had a very similar termination to that which the present debate will certainly have, to wit, that the substance in question was both hot and cold. The account above given of the physiological action of opium shows that, in moderate doses, its primary action is to excite the mind, the senses, and the circulation; that in the same dose its secondary action is to calm the system, and for a time reduce nearly all the animal actions below the ordinary standard, and

[1] Op. cit., vol. iii. p. 60.

finally, that in excessive quantities it almost immediately depresses the powers of life. Hence, upon these grounds alone, opium has an equally good claim to the title of sedative or of excitant. That either may be given to it, according to circumstances, will be still more evident when we come to consider its therapeutical applications. If the sensible effects of opium under all the various conditions of dose, state of the patient, and external influences, were accurately known, there would probably be but little disagreement among physicians in regard to the generalization of these effects, but until they are much more accurately determined than at present, it is idle to dispute about the name or names to be applied to them.

Circumstances modifying the Operation of Opium. Age.—Like other medicines, opium acts with peculiar force upon very young persons, but it is less in accordance with analogy that this substance should be much more capricious in its operation upon infants and children than upon adults. The uncertainty of its action upon the young has long been known, and has led to the reiteration by medical writers of cautions in regard to its administration. Hoffmann denounces opiates as being injurious to children, not only through their immediate effects, but as leading, in some instances, to permanent mental imbecility, and loss of muscular power, a judgment which he confirms by citations from Willis and other high authorities, and he enjoins upon those who have the care of children not to follow the popular but dangerous custom of administering anodynes for slight attacks of colic, or other pain.[1] Van Swieten, in like manner, exposes the pernicious habit of administering opiates to infants, some of whom, he says, live quite stupid and besotted to the third or fourth year of their age.[2] This habit is scarcely less prevalent and mischievous at the present day; among the lower classes, nothing is more common than to administer laudanum, paregoric, or one of the carminative and opiate mixtures, not merely to assuage pain, but to keep children asleep while their mother attends to her household affairs, or to some out-of-door employment. In England this criminal practice is, doubtless, far more general than elsewhere; for in no other European country, where the populace is so degraded, does there exist the same facility of procuring poisonous drugs. It appears from official documents that, in one district of Manchester, there were three druggists who sold *nine gallons of laudanum* weekly, of whom two testified that almost all the families of the poor of that district habitually drugged their children with opiates.[3] The same authorities furnish many examples of this vice, scarcely less appalling than the one which has been quoted, and which go far to explain the moral turpitude and mental and physical degradation of the people among whom it prevails.

[1] Opera Omnia. Genevæ, 1748. Tom. i. p. 224. [2] Op. cit., vol. xiv. p. 263.
[3] Second Report of the Commissioners for Inquiring into the State of Large Towns and Populous Districts; Brit. and For. Review, April, 1844.

It is not, however, so much the dangers of habitually using opium, by young children, as the fact that extremely small quantities sometimes produce very alarming symptoms, and even a fatal result that is most important in the present connection. Trousseau assures us that he has frequently seen narcotic effects produced in children at the breast by a dose of the wine of opium, equivalent to one-hundredth of a grain of opium.[1] We have seen upon the testimony of Barbier that a child may be narcotized by the milk of a nurse who has taken opium. Bouchardat relates that nine newborn children at the Foundling Hospital of Paris were narcotized by the decoction of a single poppyhead, and mentions two other cases, in one of which death was caused by two, and in the other by two and a half drops of laudanum. Dr. Sabotka,[2] of Vienna, has recorded six analogous cases, in two of which death followed the administration of three or four drops of laudanum. One of the patients was seven, and the other between two and three months old.[3] Among more recent cases of the same description, the following may be cited: An infant was attacked with alarming narcotism after taking one drop of laudanum; and another, eighteen months old, and affected with cholera infantum, died in six hours from an injection into the rectum of six drops of the same preparation.[4] In London, an infant four days old was fatally narcotized by one-twentieth of a grain of opium, or about one drop of laudanum;[5] and in Edinburgh the same effect was produced by two drops of laudanum in an infant also four days old.[6] In this connection it may be proper to point out the danger to the unborn child of opiates taken by the mother. The late Dr. Adams, of Banchory, was of opinion that the administration of large doses of opium to allay the irregular pains of labor, or to avert threatened abortion, is very apt to destroy the life of the child.[7]

The late Dr. John B. Beck, after citing a number of instances similar to the above, collected by him from English and American works on the diseases of children,[8] endeavors to explain the remarkable energy and uncertain effects of opium which they illustrate, by invoking the susceptibility of the nervous system, and the relatively large quantity of blood which circulates in the brain of young persons. These conditions, and the proneness of children to be exhausted by intestinal discharges, he regards as accounting for the many cases among them of poisoning by small doses of opium. Without at all questioning the justness of these opinions, we would remark that there is another function still more active in the young than either innervation or the movement of the blood, to wit, absorption, as proved by the extreme rapidity of growth during infancy and childhood. To the singular energy of this

[1] Op. cit., tom. ii. p. 43.
[2] Annuaire, etc., 1843, p. 4.
[3] Ibid., 1847, p. 5.
[4] Am. Journ. of Med. Sci., Oct. 1854, p. 384.
[5] Times and Gazette, April, 1854, p. 386.
[6] Edinb. Med. Journ., ii. 146.
[7] Edinb. Med. Journ., xiii. 422.
[8] On the Effects of Opium on the Infant Subject, N. Y. Journ. of Med., ii. 1.

function, it would seem appropriate to refer at least the disproportionate power of opium upon children; the uncertainty of its operation cannot, we suspect, be explained by any condition of their system which is not common to them and adults.

A knowledge of such facts as those above referred to has rendered physicians more circumspect than formerly in giving opiates to children. Dr. Beck very judiciously points out the precautions which should be observed in this particular. No form of opiate ought to be employed of which the strength is not accurately known; hence the syrup of poppies is not an eligible preparation. The first dose should always be smaller than the average, and never exceed one-eighth of a drop of laudanum for an infant under ten days, nor should a second be given until the effects of the first have sensibly declined.

Sex.—The greater susceptibility of females to be nauseated by opium has already been pointed out; they also require smaller doses than males, and are more liable than men to be excited instead of soothed by the medicine.

Temperament and Idiosyncrasy.—The influence of opium is most uniform and favorable upon persons of a sanguine temperament, provided that they are not suffering from a disease in which the circulation is full and excited; under these circumstances, it is apt to produce cerebral distress. The melancholic are not readily affected by opium, especially in cases when with a calm and even torpid exterior the mind is morbidly excited. This state, which is seen in an exaggerated form among the insane, is one in which large doses of opiates may be safely given. Nervous patients are very differently affected by opium; some of them it soothes and invigorates; but it must be cautiously administered to the greater number, on account of the excessive agitation, sleeplessness, excitement and distress of mind, with vomiting, spasms, and itching of the skin, which it is apt to produce. In some, the susceptibility to these unpleasant consequences is so extreme as to render the prescription of opium for them highly improper. Occasionally, indeed, a prejudice against the drug aggravates, if it does not alone excite, disagreeable symptoms; but it must be admitted that they sometimes arise where the quantity taken is extremely small and its nature is concealed from the patient. It is generally thought that the salts of morphia are less apt to disagree with the persons alluded to than opium itself. Danyau, however, reports the case of a lady affected with cancer of the uterus who was dangerously narcotized by less than one-sixteenth of a grain of muriate of morphia applied to the denuded skin of the epigastrium.[1] It occasionally happens that there is a constitutional insensibility to the effects of opium. Dr. Christison[2] says: "A gentleman of my acquaintance, not accustomed to its use, has taken 450 drops of the best laudanum without any other effect than some headache and constipation; and,

[1] Annuaire de Thérapeutique, 1845.
[2] Dispensatory, American edition, p. 710.

singularly enough, his son, at the age of six, took 60 minims of the solution of muriate of morphia without any apparent effect at all."

Habit.—The observations made under the preceding heads preclude the necessity of illustrating the influence of the habitual use of opium in modifying its curative effects. It may be remarked, however, that they show the importance of knowing when patients are addicted to the use of the drug, in order that the dose prescribed may be regulated accordingly. In connection with this point, physicians should remember that, by continuing to employ opiates longer than is necessary, they may engender a pernicious, and, perhaps, incurable vice in those who find the stimulus agreeable. Their combination with other medicines will generally prevent this untoward result.

Pain, as already intimated, modifies in an extraordinary manner the influence of opiate medicines, to such an extent, indeed, that doses which would in health prove fatal are not only unproductive of harm, but, as in some cases of tetanus, and of biliary or nephritic colic, may fail to make any impression whatever.

Combination.—Opium may be associated with nearly all medicinal agents for the purpose of modifying their action or its own effects. One of the most familiar examples of the former use is the combination of opium with mercurials, when the constitutional effects of the latter are desired. Blue mass, and calomel especially, are apt to produce a purgative effect which prevents their absorption into the system, but opium, tending rather to confine the bowels, opposes the discharge of the mercurials, and consequently promotes their absorption. It may, perhaps, conduce to the same end by blunting the sensibility of the intestinal mucous membrane. Most probably this is its mode of action when it arrests vomiting, or causes an irritable stomach to retain medicines which, without its presence, would be soon rejected. In these cases the dose of opium should not exceed what is necessary to insure its local action, a quarter of a grain, for example, or its equivalent of some opiate preparation.

Among the combinations intended to develop or augment the native virtues of opium, none is more valuable or in more constant use than its association with emetics, or nauseants, the effect of which is the production of copious diaphoresis. The most valuable of these preparations is Dover's powder (*Pulvis Ipecacuanhæ Compositus*).

Another most valuable class of preparations is formed by the combination of opium with stimulants, particularly aromatics. The only representative of this class in the Pharmacopœia of the United States is *Confectio Opii*, which contains cinnamon, ginger, cardamom, and nutmeg, and is intended as a substitute for the ancient *Theriaca*, which has been rejected by our pharmaceutists as inconsistent with that principle of simplicity regarded by them as essential in medicinal compounds. The Theriaca of Mithridates contains no less than seventy-one articles, of which fifty-eight are tonic or stimulant, one narcotic, five purgative or diuretic, and the

remainder serve to unite these ingredients in the form of an electuary. This strange assemblage of drugs may indeed deserve the name of *monstrum pharmaceuticum;* but such are the number and weight of authorities in its behalf, that the justice of its condemnation in England and in this country may, without presumption, be doubted. Even Hoffmann, while suggesting that the mixture might be simplified, declares that it would be "rash to deny and reject the experience of so many ages in regard to it," and that, however contrary to reasoning it may be to look for benefit from such heterogeneous compounds, our judgment of their value should rest upon experience alone.[1] The French Codex still retains theriaca, and, according to the most recent authorities, it is extensively used in France, because there is nothing else which so well fulfils the same indications. "It is particularly recommended in adynamic fevers, and in confluent smallpox and measles, when the eruption suddenly retrocedes, and serious disorder of the brain or chest supervenes; also when, at the commencement of an eruptive fever, diarrhœa retards or prevents the development of the eruption. It is preferable to opium in neuralgia of the stomach or intestines, especially in chlorotic subjects, and, in that case, is combined with iron. Its dose is from fifteen to twenty grains."[2] Sixty grains contain very nearly one grain of opium. It was formerly much employed with bark in the treatment of intermittents, and, at a still earlier date, was used for this purpose alone.

Diascordium, which has fallen under the same ban on account of its complexity, is composed of eighteen astringent and tonic ingredients, with opium. Sixty grains of the compound contain half a grain of opium. It is chiefly employed in chronic discharges from the bowels, and in acute diarrhœa after the febrile symptoms have subsided. The authors last quoted remark that it is easy to understand how this medicine, into the composition of which enter so many substances rich in tannin, should act in the same manner as astringents, and in addition have the faculty of relieving local pain. The ordinary pill of acetate of lead and opium, the compound powder of kino, and other similar prescriptions, are intended to fulfil this double purpose.

Without expecting, or even advocating the introduction of diascordium and theriaca into our pharmaceutical family, we could not refrain from alluding to the esteem in which they are held by observers who have no leaning whatever to medical credulity, in the hope that their example may lead practitioners in this country to pay more attention than they have done to the combinations of opiates with stimulants and tonics, and with vegetable astringents. The extensive prevalence of malarial fevers of a malignant type in the South and West, and of bowel-complaints in almost every section of the United States during the summer and autumn, would seem to present favorable opportunities of testing the virtues of these remedies or of analogous compounds.

[1] HOFFMANN, de Opii Correctione. [2] TROUSSEAU and PIDOUX, op cit.

The combination of opium with acids does not, according to Barbier, affect its medicinal qualities, and his statement is perhaps in accordance with general belief. Its correctness is rendered the more probable by the conflicting opinions of other writers. Cullen mentions the application of acids as a means of weakening the powers of opium which he found very effectual;[1] while the late Dr. Thomson declares that "with acids half the usual dose of opium will produce the effect of a full dose," a supposed result for which he found a ready explanation in the "production of a soluble salt."[2]

Action of the several Constituents of Opium. Morphia.—According to Dr. Harley's experiments, morphia, when given to the *horse* by the stomach, even in the dose of twelve grains, occasions very slight effects, or none at all; but hypodermically it brings about the same general phenomena as in man, first exciting and afterwards stupefying. But it does not produce contraction of the pupil. Upon the *dog* its action differs in no respect from its action on man; it influences both the brain and the spinal marrow, producing, successively, excitement, stupor, and paralysis, with debility of the heart. Upon the *mouse*, the effects of morphia in the order of their occurrence are as follows: cramp of the spine; restlessness and involuntary movements of the limbs; irregular breathing; stupor, and coma. It is generally believed that morphia does not exert as powerful a stimulant action either upon the circulation or the nervous system as opium. It certainly does not occasion fulness of the pulse or congestion of the head and face to the same degree, but appears to act even more decidedly as a sudorific, while it excites in a more annoying degree itching of the skin. It does not, on the one hand, appear to stimulate the mental faculties as much as opium, nor, on the other, to display so powerful a narcotic influence. Schroff, who performed numerous experiments with this drug and its constituents, remarks that although two or even three grains of opium certainly contain less than a grain of morphia, yet their action is strikingly more intense, occasioning rapidly a degree of narcotism bordering upon coma, but soon subsiding without leaving decided secondary effects behind; while morphia does not readily produce narcotism, but its after effects are of longer duration. Opium, he further remarks, increases the temperature of the body and also the sense of heat, but morphia lowers the temperature even when the sense of warmth is increased. Opium primarily augments the frequency of the pulse, and afterwards diminishes it as narcotism comes on; but morphia primarily renders the pulse less frequent. Opium is less prone than morphia to disturb the stomach and excite vomiting, or it does so, if at all, for a shorter time; and it is also much less apt to produce vesical irritation and retention of urine.[3]

[1] A Treatise of the Materia Medica, ii. 258.
[2] Elements of Mat. Med. and Therapeutics, p. 402.
[3] Lehrbuch der Pharmacologie.

Dr. Harley has particularly called attention to the various modes in which morphia may affect different individuals, among whom the greater number experience no inconvenience from its exciting action upon the brain, or its depressing action upon the organs supplied by the par vagum, while others are distressed by both of these actions, and may even have life endangered by the latter of them. Cases are recorded in which the hypodermic injection of morphia was followed by repeated attacks of syncope, with pallid skin, feeble and fluttering pulse, difficult breathing, insensibility, spasms, and vomiting. The tetanizing action of morphia upon the mouse, which is mentioned above, has its parallel in the human race. Dr. Guy mentions two or three anomalous cases in which tetanic spasms were prominent symptoms of poisoning by morphia; and Dr. Ferris relates that a woman who had taken twenty-five drops of a solution of morphia was affected as follows: the eyeballs were protruding, the corners of the mouth twitching, the arms bent and moving convulsively; she complained of great pain in her chest, could not take a long breath, had great pain in the back, and partial opisthotonos; the legs, also, twitched; she had a pulse of 60, and felt no disposition to sleep.[1]

The depression following the hypodermic use of morphia is supposed, with some probability, to arise from the too rapid introduction of the solution. It is therefore prudent, in every new case, to inject it slowly and watch its effects. According to Dr. Harley, it should at first be associated with one ninety-sixth of a grain of sulphate of atropia to counteract its possible nauseating and depressing effects. The commencing dose of morphia by this method should not exceed one-fifth or one-sixth of a grain.[2] Its effects begin to be felt in from five to ten minutes, or even almost instantaneously. These are usually acceleration of the pulse, a sense of intoxication, and contraction of the pupil. Less commonly there is a feeling of disturbance, irritation, or sinking, at the epigastrium, and occasionally an instantaneous outbreak of urticaria. As the narcotic influence gains the ascendency the pulse and breathing become less frequent, the temperature of the body falls, profuse sweating sometimes occurs, and afterwards itching of the skin, intense thirst, and dysury. The local irritation, amounting sometimes to suppuration, is chiefly due to an excessively acid solution being used.[3]

Narcotina (anarcotina) was first brought into notice as an anti-

[1] British Med. Journ., Nov. 1871, p. 555.

[2] A case is reported in which a woman suffering apparently from dyspeptic oppression with great restlessness was treated with a hypodermic injection of *two-thirds* of a grain of morphia, and, twenty minutes afterwards, *one-third* of a grain more. A few minutes afterwards she fell backwards in bed with her mouth open, and spasms of the muscles of the back. The expirations fell to three and a half per minute, but the pulse rose to 150; the sphincter ani was completely relaxed; there was no consciousness, but the breathing was not stertorous. Reaction took place under the application of ammonia to the chest. New York Med. Journ., xii. 513. The quantity of morphia used in this case, as well as its depressing operation, are very remarkable.

[3] Wilson, St. George Hosp. Rep., iv. 19.

periodic, and Sir W. O'Shaughnessy stated that when given in periodical fever "a degree of general heat follows its use in the first instance, and subsequently perspiration." Dr. Garden, in like manner, found that, in doses of from one to six grains, it rendered the pulse fuller and more frequent; and that in doses from five to fifteen grains it also occasioned diaphoresis and sometimes nausea, giddiness, and vomiting. It moreover produced constipation.[1] Schroff's experiments gave the following results: after one or two grain doses the pulse rose from six to fourteen beats a minute, and soon afterwards fell as much below the normal rate; the animal temperature underwent the same changes. Soon after the dose was taken, a transient pain was felt in the head, the face was suffused, the eyes were injected, the pupils dilated, and the perspiration increased. A disagreeable and peculiar itching of the limbs, a pleasing sense of warmth in the breast, deeper respiration, an agreeable mental condition, succeeded, and were followed by a sense of weariness and drowsiness, and with creeping chilliness, especially in the back. The operation was completed within two hours, and was not followed either by eructation or nausea. It is evident that these results do not harmonize very precisely with those of the E. Indian practitioners. The latter were drawn from an observation of the use of the medicine in several hundred cases of periodical fevers, in which, it may be added, its efficacy appeared to be very slightly inferior to that of quinia. The symptoms developed in Schroff's experiments are so nearly identical with those which a minute dose of morphia occasions that we may fairly conclude the narcotina either to have been somewhat contaminated by the latter substance, or to possess similar qualities. The latter explanation agrees with the results of Albers's experiments upon frogs, in which the narcotic operation of the drug was very manifest. Dr. Garrod administered it as a tonic and antiperiodic in thirty grain doses, without the production of any narcotic symptoms.

Codeia.—The experiments instituted by Schroff in healthy persons with this substance gave the following results: In the dose of a grain and a half it occasioned repeated eructations, severe gastric pains, nausea, and a disposition to vomit, some salivation, fulness and heat of head, with a sense of pressure in the temples, dulness of vision, and torpor of the mind, a marked depression of the pulse in strength and frequency, and a persistent tremulousness of the whole body. On the other hand, M. Des Brulais assures us that, in the dose of from one-third of a grain to one grain, it occasions neither nausea nor dreaminess, but a calm and refreshing sleep:[2] and Dr. Aran that in a larger dose it is equal to morphia as an anodyne, and superior to it in never producing a heavy and agitated sleep; that it does not bring on perspiration or eruptions of the skin, nor trouble the digestion; and that it produces neither obstinate constipation, nor any nausea or vomiting.[3] It is evident

[1] Lancet, Jan. 1862, p. 53.
[2] Bull. de Thér., li. 234.
[3] Edinb. Med. Journ., ii. 293.

that, as in the case of narcotina, the precise mode of action of this alkaloid is still uncertain. It is, however, plain that codeia possesses more narcotic virtues than narcotina; and, if we are to believe the statements just given, it exhibits the qualities supposed to belong to the deodorized tincture of opium. Dr. Aran conceives it to be peculiarly appropriate for calming the stubborn and harassing cough of bronchitis and phthisis, the severe pains of rheumatism, gout, cancer, gastrodynia, etc., which deprive the patient of rest and sleep, and for securing these blessings without the risk of disturbing the stomach or affecting the head unpleasantly. If these statements are confirmed by experience, codeia will be held as much superior to opium as opium is to other medicines of the narcotic class.

Narceia.—Experiments with this alkaloid *upon animals* led Bernard to the following conclusions: "Narceia is the most powerfully somniferous among the constituents of opium. In equal doses it occasions a deeper sleep than codeia, but not the heavy slumbers of morphia. The general sensibility is not as thoroughly blunted as by that alkaloid. The peculiarity of the sleep produced by narceia is its perfect calmness and its slight liability to be disturbed by noises. On awaking from it animals speedily regain their vivacity, just as they do after the use of codeia. When it produces death, the animal dies in a relaxed condition, and is neither excited nor convulsed."[1] These results are completely in opposition to those of Magendie and Orfila, who declared that the effects even of its injection into the veins of animals were entirely negative. Such were also the results of Harley's experiments upon dogs; but when from one-twelfth to one-half a grain of muriate of narceia was injected beneath the skin of a mouse, the soporific effects of the salt were very manifest. When the larger quantity was used, the animal died ultimately in convulsions produced by suppression of urine, which was caused by obstruction of the renal tubules, and even of the urethra, by narceia. In experiments upon pigeons with this substance Dr. Mitchell obtained only negative results.

The action of this substance *upon man* was tested by Debout in some experiments upon himself. He observed, that doses of from two-thirds of a grain to one and a half grains, occasioned no disorder of sensibility, no itching of the skin, disturbed sight, or ringing in the ears; but only natural sleep without subsequent dulness or headache; it was less apt to produce vomiting and constipation. In large doses it was apt to cause retention of urine.[2] Similar effects were noted by Laborde,[3] whose observations were made upon children, when the medicine was given in doses of from two-fifths to three-fifths of a grain; and by Eulenberg, who employed it hypodermically.[4] The last-named physician alleges that as a sedative and soporific, it acts, in the same dose as morphia,

[1] Archives Gén., 6ème sér., iv. 459. [2] Bull. de Thérap., lxvii. 145.
[3] Ibid., lxix. 224. Rec. des Travaux de la Soc. Méd. d'Observ., 2ème sér., i. 51.
[4] Prager Vierteljahrs., xc., Anal. 12.

with equal certainty and efficiency. Œttinger, however, maintains that its influence as a sedative and anæsthetic is less certain than that of morphia or atropia, and that it is also at least four times weaker than morphia. He thinks that it is to be specially recommended where it is desirable to cause sleep, and not to allay pain, or as a palliative of cough in the dose of an eighth and from that to one-fourth of a grain.[1] According to Liné,[2] among the constituents of opium narceia possesses the soporific property in the highest degree, equals morphia as an anodyne, and does not, like that alkaloid, occasion sweating, vomiting, or constipation. Petrini, a pupil of Béhier, claims such virtues for the medicine when employed hypodermically, even in minute doses.[3] Dr. Da Costa, of Philadelphia, on the other hand, found that in doses varying from half a grain to two and a half grains, it exhibits neither anodyne nor soporific powers;[4] and Fronmüller arrived at the same conclusion from no less than twenty-two experiments, in which narceia was administered hypodermically nine times, and thirteen times internally. In the latter cases the dose was gradually raised to twenty grains, and no narcotic effect was produced, nor any upon the skin, urine, or pupils. Subcutaneous injections produced no effect. Kersch, in experiments upon animals, reached the same negative result.[5] Dr. Harley concludes from his experiments that narceia taken by the stomach is a pure but feeble hypnotic in doses exceeding five grains; that when introduced by the skin one grain is equivalent to only the one-eighth of a grain at most of a salt of morphia; and that, finally, it is practically useless as a medicine.[6]

Meconine.—Dr. Harley found this alkaloid, given hypodermically, nearly inoperative upon the horse and the dog, but a gentle soporific in its action upon the mouse. Given to man by the mouth, in the dose of five grains and upwards, its action was perfectly null; but hypodermically in doses of from half a grain to one grain and a half, he observed a decidedly hypnotic effect which he compares to that of narceia. Dr. Mitchell confirms the statement by Dr. Harley of its negative action when given internally; but when placed under the skin of a pigeon, even in large quantities, it produced no characteristic effects.

Cryptopia.—This alkaloid forms soluble salts with muriatic and acetic acids, which were employed by Dr. Harley in his experiments.[7] In dogs, one or two grains of cryptopia produced sometimes excitement followed by sleep, and sometimes sleep without any previous excitement. A similar variation of effects may be observed in the cat and rabbit. In the former of these animals the alkaloid produces slobbering and a curious stiffness of the limbs, with jerking of the muscles of the head and trunk. In one instance

[1] Brit. and For. Med.-Chir. Rev., April, 1867, p. 527.
[2] Etudes sur la Narceine, 1865. [3] Bull. de Thérap., lxxxii. 136.
[4] Penn. Hosp. Rep., 1868, p. 177.
[5] Brit. and For. Med.-Chir. Rev., April, 1869, p. 515.
[6] The Old Vegetable Neurotics, p. 150.
[7] Old Veg. Neurotics, p. 156; St. Thomas's Hosp. Rep., 1871, p. 123.

"the tail was extended and curved upward near the root; the body rigid and tremulous, apparently impelled forwards, and the impulse resisted or balanced by a rigid advance and set of the fore legs." Later choreic movements affected the whole body, and these were followed by convulsions and rigid spasms. Nevertheless the animal, which was a young one, and owed all these symptoms to one grain of cryptopia employed hypodermically, entirely recovered. In the rabbit similar symptoms were produced, and ultimately death, by a hypodermic injection of five and a half grains. The mode of death appeared to be by spasm of the respiratory muscles. On *man* the hypnotic effect of cryptopia is marked in those who are readily calmed with morphia, and is about one-fourth as strong as that alkaloid. In its usual mode of action it resembles morphia without producing any of the usual unpleasant effects of that medicine. According to Dr. Harley it stands midway between morphia and thebaia, sharing equally the qualities of both. The sleep of cryptopia is as prolonged as that of morphia, but is lighter and more refreshing, and is not attended with illusions nor followed by nausea.

According to the same authority, *thebaia* displays both a tetanizing action and a hypnotic effect, but in the lower animals the former greatly exceeds the latter; thus, in the rabbit, a dose of two grains hypodermically produces a powerful cramp of the respiratory muscles which proves fatal by exhausting the arterial blood of its oxygen. In man it exerts its soporific effect in subcutaneous doses of a grain and a half, which is nearly equivalent to a quarter of a grain of a salt of morphia, and it does not occasion any unpleasant effects.

The action of *papaverine*, as stated by Leidesdorf and Breslauer, seems to vary like that of thebaia, since it is hypnotic without being stimulant, and does not occasion vomiting, giddiness, or unconsciousness. Nor does it constipate. Its action is slow in beginning, but very durable.[1] According to Wetter, on the other hand, it acts more promptly than morphia, and occasions a longer and deeper sleep; it also contracts the pupil, and reduces the frequency of the pulse. The slowness of its action is owing to its great insolubility.[2] These statements are opposed to that of Bernard, who holds papaverine to be merely tetanizing and not in the least narcotic; and to those of Hoffmann, who declares that in man a dose even of six grains does not exert the slightest soporific influence, nor any depression or relaxation, nor any action on the pulse, kidneys, or bowels.[3] It is hardly possible that the same substance was used in these different experiments.

Modes of Administration.—Opium and its preparations are administered by the mouth, the rectum, and the skin. The first is the most usual medium, and in the absence of any special contraindication, the most eligible when a prompt and general influence

[1] Practitioner, i. 125. [2] Prager Vierteljahrs., 105, Anal. 9.
[3] Archives Générales, March, 1869, p. 357.

is intended. By the rectum a double dose may be give in the form of enema or suppository. Opiates are applied to the unbroken skin in plasters, fomentations, and liniments, for assuaging local pain; upon the cutis, denuded of its cuticle, as well for this purpose as for affecting the system; and hypodermically in cases which will be more particularly described in the sequel. When a salt of morphia is sprinkled upon the skin from which the epidermis has been removed by a blister, it excites a severe smarting and burning pain; on this account the morphia is usually mingled with finely-powdered starch or gum Arabic, or else incorporated with lard. According to Barbier, the endermic method is not fully to be relied upon, for he found that in some cases no narcotic symptoms followed the application, while in others, under precisely similar circumstances, it gave rise to all the phenomena produced by opium taken internally.[1] The late Dr. James Johnson[2] proposed the inhalation of the vapors of opium by smoking it in a common pipe. This would, beyond a doubt, procure more rapidly and completely the sedative or anodyne influence of the drug than any of the other modes of administering it, and might at least be employed with those who habitually smoke tobacco. Powdered opium mixed with tobacco, or the latter steeped in a solution of the narcotic extract, would form an eligible means of obtaining the object in view, especially when the smoker is accustomed to draw the smoke into his lungs.

The *hypodermic* use of morphia, like all other newly introduced methods, has been abused, not only by physicians, who employed it with undue frequency, and with too large doses of the alkaloid, but by the patients themselves. The alleviation of pain, and the pleasing intoxication which succeeds it, form too strong a temptation to be resisted by many persons who are tempted to employ the remedy without medical advice, or to continue its use after the physician has ceased to employ it. Like alcohol, its intoxication leaves behind it a sense of debility and depression which nothing relieves but a fresh resort to the medicine. Like all other nervous stimulants, it creates, if continuously employed, an artificial necessity for a resort to its powerful and genial support; and the longer it is used the larger must be the dose injected to afford the original degree of relief. The peculiar allurement of the habit, as compared with that of opium eating, consists in this, that it does not so readily derange the stomach, impair the appetite, or induce constipation. But quite as surely, and even more rapidly, it undermines the nervous system, and develops a morbid susceptibility to pain which augments with the frequency of the operation. It is very true that there are many cases of protracted and painful, perhaps of incurable disease, in which the danger of forming the "morphia habit" ought not to deter us from the sufficient and continuous use of the drug. In such cases life must be made tolerable, *coute qui coute;* but they are not proper examples to follow in acute

[1] Op. cit., iii. 31.

[2] Med.-Chir. Rev., April, 1842.

affections, which either have a natural tendency to recovery, or in which other remedies, which are less promptly palliative, are more radically curative; nor should they tempt us, in less serious cases, to exceed the smallest dose which will give relief, nor to repeat that dose unnecessarily.

Remedial Employment.—In treating of this portion of our subject, we shall, in the first place, consider the uses of opium in diseases which involve the whole system, or which, in whatever part of it they occur, are attended with the same prominent and essential phenomena; and subsequently such of these as are more or less modified by the organ which they chiefly involve, together with affections of a still more local nature, and which are seated almost exclusively in a single organ or apparatus. Idiopathic fevers, inflammation, hemorrhage, and some chronic constitutional affections are included in the first class; and in the second disorders of the several groups of organs combined in the performance of particular functions.

Fevers.—Nothing is more embarrassing than an attempt to learn the use of opium in fevers from what has been written upon the subject, in consequence of the confusion in which the diagnosis of these forms of disease continues to be involved. Some, even the most modern writers, are not perfectly agreed whether to regard typhus and typhoid fevers, the only two simple and serious continued fevers now admitted, as specifically different, or as only varieties of the same affection. The older medical authorities render the inquiry still more perplexing to us by including many of the phlegmasiæ or local inflammations in the class of fevers, and also by failing to distinguish them when they arise as complications of genuine idiopathic fevers. To learn, therefore, the opinion entertained by one of these writers in regard to the uses of opium or of any other medicinal agent in continued fevers, it becomes necessary to compare carefully the history of the disease in which it was used by him with those types which personal observation or the more minute and methodical descriptions of later times have rendered intelligible. Without at present attempting so arduous a task, we shall aim only at pointing out the precepts which experience has approved, and which, therefore, deserve confidence in proportion to their antiquity.

Among those which have been longest in authority are the following: "Opiates ought not to be prescribed at the onset nor at the climax of a fever, but either during its augment, to assuage its violence, or during its decline, to support the strength and calm the nervous symptoms which are then apt to arise. In the former case they should be preceded by evacuants, and in both, if the head is hot, their influence will be promoted by the application of cold. The latter expedient is equally commendable in maniacal delirium, in which also opiates should be associated with nitre or some other sedative of the circulation. In this case, and also in mere watchfulness, or to combat ataxic symptoms, many authors recommend that opiates should be given in frequent and divided doses, so as

to maintain a permanent effect, for large and infrequent doses will not control the evil symptoms without inducing a dangerous degree of stupor and subsequent exhaustion."[1] Hoffmann, who does not appear to have approved the ordinary use of opium in continued fevers, reiterates the caution against prescribing it upon the invasion of the attack, or when a crisis is about to take place. Sydenham, in describing the treatment of the continued fever observed by him from 1661 to 1664, and which, from its symptoms and its ordinary duration, was probably typhus fever, strongly recommends opium against one of its complications, maniacal delirium, or, as he terms it, phrenesis. In this state, he says, the patient cannot sleep, but cries out, mutters indistinctly, looks and talks wildly, and greedily swallows whatever is offered to him. After reducing, by means of evacuants, the violence of the symptoms, and not before the twelfth or fourteenth day from the commencement, Sydenham advises that a full dose of some opiate be given, by which means he declares that the delirium and fever are together brought to an end.[2] Cullen speaks of the value of opium in counteracting the delirium of fever, and agrees with previous writers in pronouncing it "a dangerous, or at least an ambiguous remedy" during the active stage of the disease.[3] But he is very careful to distinguish between its use in cerebral inflammation and in simple delirium with watchfulness and subsultus tendinum. In the latter he declares it to be a sovereign remedy, and directs it to be given in full doses every eight hours, unless sleep and a remission of the symptoms shall allow of longer intervals; but in the former, he says, it is most pernicious. It is extremely difficult, in many instances, to determine whether or not delirium is symptomatic of inflammation of the brain, nor can any more certain criterion be adopted than the effect produced by a small dose of an opiate or stimulant medicine; if, instead of growing more tranquil, the patient talks quickly, and his eye grows brighter, opium is clearly contraindicated.

Typhus.—Hildebrandt[4] has very distinctly pointed out the proper occasion for prescribing opium in this disease. He insists that in the course of a simple attack of typhus it is not only unnecessary, but may be dangerous; by augmenting the stupor, and opposing the critical tendencies of the system, it prolongs the disease, tends to bring on apoplexy, and interferes with the salutary operation of other remedies. Its exhibition should be restricted to cases complicated during their decline, with furious delirium, or profuse discharges from the bowels. In Great Britain, also, opiates are directed against these symptoms, but more particularly for the relief of tremors, watchfulness, and low delirium. Roupell states that at St. Bartholomew's, during an epidemic of the malady, it was "a daily occurrence to find that a patient who had been without

[1] Theophili Boneti, Polyalthes, etc. Genevæ, 1693.
[2] Sydenham's Works, chap. iv. [3] Op. et loc. citat.
[4] Du Typhus Contagieux, trad. par J. C. Gasc. Paris, 1811.

sleep for several nights, whose whole frame was in a state of tremor, actuated by some erroneous idea, and constantly endeavoring to get out of bed, falls into a tranquil slumber on taking a dose of opium, and awakes refreshed and conscious, after several hours of calm and gentle sleep, during which the secretions will often be restored, the tongue becomes moist, and a warm perspiration breaks out."[1] Under these circumstances, the result is to be obtained by such a dose of opium as will soothe without stupefying, and is to be repeated at proper intervals. Dr. Latham ascribes no less importance to opium as a means of removing the symptoms above described; and Drs. Gerhard and Pennock, who had ample opportunities of treating the disease in the Philadelphia epidemic of 1836, state that when "the insomnia has been tormenting and incessant, and the patient was exhausted by agitation and nervous restlessness, a small dose of morphia would generally calm the agitation and procure sleep."[2] Dr. Gerhard further remarks that typhus patients are very easily affected by opiates, and that an eighth or a sixth of a grain of morphia was usually sufficient for the purpose in view.

Dr. Graves[3] has furnished some striking examples of the curability of severe cases of petechial typhus by means of a plan of treatment into which opium enters largely. Among the symptoms which he describes as indicating it are violent delirium, a furious aspect, suffusion of the eyes, constant raving and muttering, and perfect sleeplessness. Under these circumstances he administered every second hour a draught containing half a grain of tartar emetic, with ten drops of laudanum, and, if there was much subsultus, five grains of camphor. This mixture brought on vomiting or purging, or both, and at the same time the patient grew more tranquil and rational. Here the combination of sedatives and opiates effected what neither was capable of doing by itself.

Typhoid Fever.—The diseases described by Huxham under the names of putrid malignant, and slow nervous fevers, correspond in their prominent traits with the typhus and typhoid forms of the existing nomenclature; the distinction is maintained in the treatment recommended for each by this eminent physician. While in the former he strongly recommends opium, particularly in combination with camphor, he finds but little occasion for its employment in the latter, declaring that strong opiates "are commonly pernicious, however want of sleep, or great restlessness may seem to demand them," for which symptoms indeed he insists upon blisters to the back of the neck.[4]

The general remarks which have been made on the use of opium in fevers may be regarded as applicable almost as much to typhoid fever as to typhus, whenever the delirium is marked by talkativeness and excitability rather than by maniacal fury or by comatose

[1] A Short Treatise on Typhus Fever (Philadelphia, 1840), p. 146.
[2] Am. Journ. of Med. Sci., Feb. 1837.
[3] A System of Clinical Medicine, Dublin, 1843, p. 127 et seq.
[4] An Essay on Fevers, London, 1772, p. 82.

muttering. Since the distinct separation of typhoid fever from other continued febrile disorders, few accounts have been published respecting the influence of opiates on its symptoms. Louis, indeed, informs us[1] that he found it effectual, when given in small doses, in moderating subsultus and delirium in mild cases of the disease, and suggests that the success of these experiments should encourage its employment in severer cases. Dr. A. Flint found that full doses of opium exerted a decidedly beneficial influence upon the symptoms and even the duration of several cases in which he administered it in large doses, while in others it did not appear to control the progress of the disease.[2] More recently Dr. Limousin has called particular attention to the advantages of opium when ataxic delirium is a prominent symptom, and to the occasional occurrence of crises by sweat or urine, as the cerebral excitement subsides.[3] Opium is of no less value as a means of restraining the diarrhœa, and of averting the consequences of intestinal perforation, which sometimes augment the gravity of typhoid fever. To these points reference will again be made.

Eruptive Fevers.—In these diseases, when they assume the typhoid type, opium is needed under circumstances similar to those which have just been described; but there is a still more important occasion for its exhibition, when the eruption comes out imperfectly, or shows a disposition to recede. It has been chiefly used to meet the former of these indications in the treatment of smallpox. The ancients recommended that if the eruption did not appear actively by the fourth or fifth day, the patient should be well covered in bed, and steamed with watery vapor, while hot aromatic drinks with laudanum and camphor were administered.[4] Sydenham, Morton, and Young inculcate similar precepts. The modern practice differs in no essential particulars, as may be seen in the following citation from Dr. Gregory's Lectures. During the initiatory fever, "if the circulation be languid, if the pulse be small and feeble, the skin pale, and the extremities cold, if the patient lies on his back, sunk and exhausted, let him have immediately warm brandy and water, cover him with bedclothes, apply mustard poultices to the centre and extremities of the circulating system, and give thirty drops of laudanum, to be repeated in four hours if necessary. This cordial plan of treatment must often be continued for several days."[5] In measles and scarlet fever opiates are not used to combat symptoms like those just described, but in its stead the more simple and direct stimulants, particularly wine and heat.

Intermittent Fever.—Before the introduction of cinchona into medicine, many agents were successively employed for the cure of intermittents, which the specific virtues of bark have led us, perhaps unwisely, to neglect. Of these, opiates were among the most esteemed. They were prescribed either before the paroxysm, to

[1] Recherches, etc., sur la Fièvre Typhoïde, 2ème éd., tome ii. p. 453.
[2] Clinical Reports, p. 266. [3] Archives Gén., Aug. 1863, p. 150.
[4] Bonetus, op. cit., tom. i. p. 345.
[5] Lectures on the Eruptive Fevers, Lond. 1843, p. 84.

prevent it, or during its progress, to moderate the severity of the fever. Even since the prevalence of the treatment by bark and its preparations, many of the most eminent practitioners in all countries have recommended that opium should be substituted for or combined with the antiperiodic medicine. Sydenham, Hoffmann, Van Swieten, and Cullen particularly insisted upon its use, and the last mentioned author minutely indicated the conditions for its employment.[1] When used before the paroxysm, it should be in the manner prescribed by Sydenham, who directed the patient to be sweated with warm whey four hours before the attack, and upon the first appearance of moisture on the skin, to take a dose of a mixture made with brandy, theriaca, and saffron, and by these means maintain the perspiration for several hours beyond the ordinary time of the attack. In autumnal tertians, this treatment was associated with purgation. Lind has furnished more details than any other writer of the effects of opiates in the hot stage of intermittents, and his large experience enabled him to speak with authority. He declares that opium shortens and abates the hot fit, relieving the head, producing perspiration with an agreeable softness of the skin, and often a gentle and refreshing sleep; it also renders the intermission more perfect, and appears to prevent the occurrence of dropsy and jaundice as sequelæ of the disease.[2] Many cases of intermittent fever get well under this treatment alone, or with the addition of a course of vegetable bitters, but those, even, which it fails to cure may by its means be rendered more amenable to the influence of bark and its preparations. It should, therefore, be more commonly employed than at present. Recent experience in the treatment of *periodical fevers* leaves no doubt of the importance of hypodermic injections of morphia in mitigating the severity of the approaching paroxysm and even in preventing it entirely.

It is scarcely necessary to remark that opium is sometimes an important corrective to cinchona or quinia, when the stomach is disposed to reject either medicine, and also when they produce diarrhœa. Under these circumstances, it is, indeed, no more than an adjuvant; but even in rendering the valuable services previously described, it acts only as a palliative, and that not so much of essential symptoms, as of those which; however grave they at times may become, are nevertheless incidental, to wit, delirium, ataxia, diarrhœa, etc. If, then, we estimate inductively the measure of utility possessed by opiates in idiopathic fevers, we find that it depends almost entirely upon the control which they exert over the disorders of the nervous system, and upon their sudorific virtue, qualities which inherently belong to them. The diseases in question do, in certain stages, permit these qualities to act therapeutically, while at all other periods the exhibition of opiates only tends to aggravate the fever and cerebral disturbance. Hence their proper administration in essential fevers depends altogether upon

[1] See SCHAERTLICH, cited by BAILLY, for a summary of authorities.
[2] An Essay on Diseases, etc., in Hot Climates. Philad. 1811, p. 234.

its opportuneness, and, to be safe, or at least efficient, requires the guidance of a cautious and experienced hand.

Inflammation.—If we regard only the phenomena which are essential to inflammation, those, namely, which are strictly local, it may be doubted whether the internal use of opium has any direct power of controlling them; but these local inflammatory symptoms are frequently aggravated and perpetuated by concomitant states of the general system, or by the peculiar circumstances of the diseased organ, and over these conditions opiates in many cases exert a paramount influence, thereby indirectly tending to cure the inflammation. In general terms, their effects may be illustrated by those of rest upon an injured limb; they remove or hold in check causes of irritation, and thus allow the recuperative powers of the inflamed part to act without hindrance. It is in this manner, probably, that must be explained the very unequal, and indeed opposite, effects of opium in the inflammations of different organs, as will be shown in a subsequent paragraph.

Of the constitutional states which exasperate inflammation, and are beneficially affected by opium, none is more prominent than *nervous excitement.* It is shown by restlessness, watchfulness, great susceptibility to external impressions, and to pain, a quick, rapid, and either feeble or hard pulse, and oftentimes a disposition to copious and exhausting perspiration. Such a state is of common occurrence in chronic diseases of all kinds attended with wasting discharges, and especially with hemorrhage or suppuration; in acute affections attended with much pain, or occurring in persons of a strongly marked nervous temperament, or in those whose strength has been impaired by previous disease, the abuse of mercury, narcotics, and alcoholic stimulants, or by unwholesome and scanty food. Intense pain frequently induces a similar condition, a fact which may perhaps account for the great mortality after severe operations. From observing the hurtful influence of the nervous shock after dangerous wounds and operations, M. Malgaigne was led to prescribe in such cases enough opium to keep the patients fully under its influence until the danger of inflammation had gone by.[1] He reports very favorably of the trials he had made of this method, which, to some extent, at least, has long been employed by surgeons in this city, and probably elsewhere. Universal experience concurs in recommending that, in acute inflammations of an active form, opiates should be given in full or sedative doses, and directly after depletion. Their usefulness, when thus prescribed, is doubtless owing, in a great degree, to their preventing that irritability of the system which loss of blood is so apt to occasion, and at the same time retaining the pulse at the point to which depletion had reduced it. To fulfil this indication, the opiate influence must be maintained for a sufficient time.

Hemorrhage.—The remarks made in reference to the antiphlogistic use of opium are in all points applicable to its employment

[1] Bulletin de Thérapeutique, xiii. 290.

against hemorrhages. Except in so far as it moderates the action of the heart, opium has no direct influence whatever upon sanguineous discharges; its direct operation, however, is highly beneficial by subduing, as Dr. Chapman expresses it, the mobility of the system which is productive of, or at least is commonly associated with, passive hemorrhages.[1] In that state which was more particularly described above as an incident of inflammation, and which is equally so of hemorrhage, opium is not only a useful, but an indispensable remedy; but where loss of blood depends upon plethora, opium must on no account be administered, nor, in the majority of such cases, indeed, is it necessary to interfere at all.

Gangrene.—In all forms of mortification attended with pain, opium may be advantageously employed, but it is in that form of gangrene called *senile*, and which comes on with blackening and shrivelling of the part, that opium has been most valued. In this case, by combining it with tonics and stimulants, the system is enabled to limit and throw off the slough. Percival Pott, who first introduced this treatment, was in the habit of directing two grains of opium to be given to the patient night and morning.[2] Dr. Eberle, in confirming the high opinion entertained by Pott of opium in this disease, remarks that in a case successfully treated by himself, the patient took from six to eight grains in twenty-four hours, given in divided doses at intervals of four hours.[3]

Diseases of the Nervous System. Pain.—The anodyne powers of opium are certainly those which are most frequently invoked and most highly valued, and there is indeed no form of pain to which they cannot afford at least a temporary palliation. But among the disagreeable local sensations which are included in the idea of pain, there are many varieties, particularly the smarting, the burning, the itching, the throbbing, the tensive, and the lancinating, of which the last is more decidedly amenable than the rest to opiate medicines, perhaps because it is, more usually than they are, independent of lesions of structure in the tissues surrounding the nerves which are the seat of pain. In general, opiates relieve pain by blunting the sensibility, whether they do this by acting on the brain or by their direct impression on the nerves of the diseased part to which they are applied; but they also act, in many cases, by moderating the movements of the organ by which the suffering is mainly caused, as in the case of inflammatory affections of the lungs and bowels, the twitching of amputated or injured limbs, the chordee of gonorrhœa, etc. One of the most remarkable facts connected with the use of opiates in painful disorders is, that, during extreme suffering, doses of these medicines may be taken with impunity which would under other circumstances be mortal. This is the case in tetanus, some forms of neuralgia, and during the passage of biliary and urinary calculi through the gall-ducts and

[1] Elements of Therapeutics, 4th ed., ii. 177.

[2] A treatment by opiates and alexipharmics was still earlier employed. Vid. F. Hoffmann, De Sphacelo.

[3] Op. cit., p. 341.

ureters. It has been urged, not without justice, that "to stupefy the sensibility to pain, or to suspend any particular disorder of function, unless we can simultaneously lessen or remove the causes which create it, is often but to interpose a veil between our judgment and the impending danger,"[1] but in regard to pain, at least, there are but few cases to which the remark is applicable. In some, opiates aggravate the inflammatory or nervous symptoms, and are, therefore, not the appropriate means of relieving pain, as in cerebral inflammation or functional disorder with cephalalgia; in almost all others it is certain that the morbid process will not be aggravated by the alleviation of the pain attending it. Wherever pain is the only, or even the best index of danger, insensibility to it is plainly to be deprecated. Dr. Buck and Dr. Watson relate several cases of strangulated hernia, in which opiates were administered under a wrong impression of the nature of the attack, and so effectually lulled the pain as to mask entirely the state of the patients. In one instance the true state of the case was not discovered until too late for the operation to be of service.[2]

A question of much importance, relating to the use of opium, is thus stated by Dr. W. Griffin, of Limerick: "When a large dose has been administered, and a patient is still suffering intense pain, how long should one wait before it could be considered safe to repeat it?"[3] In half an hour, this author thinks, some effect will be observable from a dose of opium capable of affecting the system at all, and perhaps in a few minutes sooner from a solution of the active principles of the drug. But this relates only to full doses of one or more grains; such, in other words, as are sufficient to produce a directly sedative effect. If the pain is periodical, it is better not to wait for the accession of the paroxysm to administer opium, but to anticipate it by an hour or two, in which case one-third of the dose that would otherwise have been required will be found sufficient.

Sleeplessness.—The sleep produced by opium is only a higher degree of the anodyne effect of this drug, and in so far, therefore, as pain prevents sleep, or the latter relieves pain, the remarks under the preceding head are equally applicable to the present. But the inability to sleep may depend upon other causes, some of which are far from being well understood, but the most familiar of them are over-excitement of the mind by thought, and that analogous state of morbid mental activity seen in mania, delirium tremens, low fevers, etc. Insomnia accompanying inflammatory disease within the cranium, like pain under the same circumstances, can be neither safely nor successfully treated by opiates; but in all other cases this symptom may be relieved by a treatment of which opium forms the essential part. It is not easy to lay down certain rules for producing a soporific effect by opium; in general, a grain or more

[1] Dr. Holland's Medical Notes and Reflections. On the Use of Opiates.
[2] N. Y. Journ. of Med., Nov. 1844.
[3] Medical and Physiological Problems (London, 1845), p. 191.

must be given if a prompt result is sought for, while a smaller dose, taken several hours before the usual bedtime, will equally well procure a quiet night's rest, after having in some measure displayed its stimulating powers. On the other hand, it sometimes happens that the larger dose proves the less sedative, occasioning a restless, oppressive, and unrefreshing drowsiness, which seems to be ever approaching, without merging into sleep. In such cases the physician is very apt to prescribe a still larger dose of opium on the succeeding night; this is a serious error, for the patient will generally be found to sleep well on that night without any opiate at all. The special action of *narceia* as a hypnotic has already been referred to. It is deserving of further trial in the class of cases in which sleeplessness rather than pain is to be controlled.

Insanity.—In the active forms of mania, opiates are rather hurtful than beneficial, especially when there are evidences of a determination of blood to the head. Esquirol disapproves of them in such cases, and is sustained by almost universal experience. Feuchtersleben[1] says, "opium as a soporific, either fails altogether in producing sleep, since in mania the largest doses are often taken without effect, or the patients are more raving than ever when they awake." In cases of melancholy monomania, where paroxysms of violence are brought on by the perpetual corrosion of some terrible idea, opiates succeed in preserving calm by blunting in some degree the sensibility to mental anguish, but beyond this they exert no curative influence; the moment they are withheld the mischief breaks out anew. Opium may also be used as a palliative in true hypochondriasis, or that form of mental disorder in which most of the delusions relate to bodily ailments. These remarks are sustained by the experience of Erlenmayer. He holds opium to be the most important medicine in the treatment of insanity, and particularly in recent cases. Its efficacy, he states, is almost uniform in puerperal insanity, and next to this in mental derangement depending upon ill health, provided there be no disease of the brain itself. Dr. E. remarks that it is generally well borne, and that if it is not, its use should not be persisted in. It should be prescribed in doses of one or two grains from the first, and gradually increased until improvement is manifested, and when this point is reached the dose may remain stationary, unless the symptoms become aggravated.[2] Since the introduction of the method of hypodermic injection, morphia has been used in some cases with signal benefit not only in calming violence but in effecting a permanent cure. Cases of acute puerperal insanity, and of other acute and chronic forms of mental derangement, have been not only controlled and mitigated but apparently cured by the subcutaneous injection of from one-quarter to half a grain of morphia at intervals of from three to twelve hours.[3]

[1] The Principles of Medical Psychology, Sydenham Soc. edition, p. 352.
[2] Prager Vierteljahrs., lxxi. Anal., 106.
[3] Bull. de Thérap., lxxv. 334; Practitioner, ii. 272.

Delirium Tremens.—Since Dr. Pearson's notice of the opiate treatment of this disease (1801), the great majority of practitioners have adopted it unreservedly. Most of them, with Dr. Chapman and Dr. B. H. Coates, declare that "sleep is the *sine qua non* to a recovery" from delirium tremens. The latter gentleman has ably maintained this view in a well-known Essay, in which he lays it down as a rule that "a certain effect is to be produced *coute qui coute*, and we must go on exhibiting opium in considerable doses at such short intervals as are sufficient to permit its accumulation in the primæ viæ, until enough has been taken to produce sleep."[1] Dr. Coates mentions a very severe case which terminated in cure, and in which sleep was not procured until forty-five grains of opium had been given in hourly doses of about six grains each. Such a heroic method would scarcely find partisans since the results of the expectant plan, and of that by alcoholic stimulants, have been distinctly ascertained. Dr. Ware and Dr. Gerhard especially have contributed to place the opium treatment of delirium tremens upon the proper footing. The following summary of an analysis of Dr. Ware's cases is given by himself: "It appears that of 15 cases in which opium constituted the principal remedy, 6 died; whilst of 54 in which opium was not used at all, or only incidentally and in small quantities, only 5 died. Still further, if we separate from these 54 the 9 cases in which the treatment was eclectic, and in which the mortality seems to have arisen from the combination of acute disease, we have a remainder of 45 cases, of which only 2 were fatal. Again, if we compare the mortality of those cases in which opium was pushed to the full extent advised by writers on this disease, with those in which no active remedy was employed, we have a mortality of 1 in 2, against a mortality of only 1 in 29."[2] Quite recently, Dr. Peacock announced the rate of mortality at St. Thomas's Hospital under the opiate treatment to have been 30 per cent.[3] It appears from Dr. Gerhard's statements, that, at the Philadelphia Hospital, Blockley, the mortality from delirium tremens, managed upon the opiate plan, varied between 1 in 8 and 1 in 11, while after the method was abandoned, it fell in successive years to 1 in 26, 1 in 34, and finally, to 1 in 160.[4]

A moderate employment of opium, however, does certainly aid in moderating the violence and abridging the duration of the attack, and the best mode of exhibiting the medicine is undoubtedly to begin with a quarter of a grain, or its equivalent, and progressively to augment the dose by small and hourly additions until sleep is produced, or a sufficient degree of tranquillity obtained. But the whole amount of opium thus given should not much exceed what might be safely prescribed in ordinary painful affections; for this cannot be done without great danger, a danger to which no patient should be exposed whose life is not in imminent peril from disease. Such a condition is found in traumatic tetanus, from which few or

[1] N. A. Med. and Surg. Journ., iv. 214.
[2] Am. Journ. of Med. Sci , Nov. 1831, and Aug. 1838.
[3] Times and Gaz., Aug. 1861, p. 105.
[4] TWEEDIE'S Library of Pract. Med., Am. ed., ii. 244.

none recover without active treatment; it does not exist in the disease before us, in which, when uncomplicated, few would perish, although left without medicinal treatment altogether, if proper food and exercise were prescribed. Dupuytren, alluding to the importance of using opium in delirium tremens following surgical injuries, insists upon the importance of giving it by the rectum rather than by the stomach, which organ is not in a condition to absorb it.[1] Hypodermic injection is preferable to either.

Inflammation of the Nervous Centres.—By common consent opiates are discarded from the treatment of acute inflammation of the brain and its membranes; in the decline of the disease, however, and particularly when the antiphlogistic method has been vigorously employed, they are sometimes useful in combating the wakefulness and jactitation which have already been spoken of as calling for these remedies. In *epidemic meningitis* opium is by far the most useful among the many medicines which have been resorted to for the cure of this fatal disease. It was first used efficiently by Strong during the epidemic which prevailed in the United States at the beginning of the present century, and his example was followed by Haskell, Miner, and others. In Europe it was lauded by Chauffard and Boudin, and from our own observations of its influence during an epidemic of the disease, we are satisfied that it is of all internal medicines the most efficient, and indeed the essential remedy. Its advantages are, however, most apparent when it is administered as nearly as possible at the onset of the attack, and in those cases in which the inflammatory predominates over the septic element. Their prominent symptoms are delirium succeeded by tetanic spasms, particularly of the spinal muscles.

Sunstroke.—In cases of this affection marked by nervous symptoms, such as convulsions, jactitation, delirium, and general excitement, Dr. James H. Hutchinson gives a favorable report of the hypodermic injection of morphia in the dose of a quarter of a grain.[2]

Convulsive Diseases.—When *epilepsy* arises from organic causes existing within the cranium, or from hereditary predisposition, neither opiates nor any other medicine can be expected to remove it; but when produced by strong mental emotion, or severe bodily pain, the violence of the attacks may be palliated by opiates; they may also be moderated in the same way when their premonitory symptoms are of sufficient duration to permit the influence of a full dose of opium to be established before the convulsive movements. Similar remarks apply to *hysteria*, especially to cases in which the paroxysms are brought on by pain. Scanzoni employed the hypodermic injection of morphia in a case of *puerperal eclampsia.* Two striking cases are reported of its value by Dr. Bowstead,[3] and others by Dr. Bontecou, of New York;[4] and the endermic method was resorted to with success by Bernard to relieve *spasm of the glottis* in a nervous person of adult age.

[1] Clinical Lectures, Sydenham Soc. ed., p. 292.
[2] Penn. Hosp. Reports, ii. 291.
[3] Lancet, May, 1869, p. 747.
[4] New York Med. Journ., xi. 176.

Chorea.—Sydenham is generally referred to as resting upon opium the treatment of St. Vitus' dance, but in truth he only employed this agent to calm the agitation likely to be occasioned by the repeated bleedings and purgations which he directed. Trousseau is, we believe, the only authority in favor of an almost exclusive treatment of certain cases of chorea by opium. His opinion is the more important, inasmuch as it resulted from the treatment of fourteen cases which had proved intractable to other methods, and of which all but one recovered rapidly under the new remedy, which was employed in the following manner: Half a grain of opium was prescribed every hour until the convulsive movements were clearly moderated and some narcotism felt; this state was maintained by increased doses of the medicine during from five to eight days; they were then suspended, and baths directed. After an interval of two or three days, the opium was resumed. In this manner, we are assured that, by the end of a fortnight, it rarely happened that nature was not able to complete the cure.[1] Confined to the class of cases in which M. Trousseau employed it, this practice is highly deserving of imitation, but in the earlier stages of the affection it should be remembered that other remedies have a stronger claim to confidence, and also that chorea will often get well without any active treatment whatever.

Tetanus.—From a somewhat attentive examination of the subject, we have arrived at the conclusion that idiopathic and traumatic tetanus are two distinct diseases, the latter being a functional disorder of the nervous system, and the former, in nearly every case, spinal meningitis. This difference, we are convinced, explains the conflicting accounts recorded of the results of treatment in tetanus. It is in traumatic tetanus that opiates have been most successfully and generally employed, although in ordinary doses they have but little power in controlling the spasms or inducing sleep. As much, even, as an ounce of opium has been taken daily without producing these effects. A part of this singular inactivity arises from the stomach not acting upon the medicine. Mr. Abernethy found in the stomach of a person who died of tetanus thirty drachms of undissolved opium, and other physicians have recorded similar cases. These facts ought to dissuade us from administering excessive doses of the drug in tetanus and in other diseases; for, supposing the patient who has taken so much opium to begin to improve, the first effect of his improvement will inevitably be his death from narcotism. The truth is, however, that those who have swallowed such extravagant doses of opium as are mentioned above, without being narcotized, invariably die, while such as have appeared to improve under the opiate plan have experienced its narcotic and antispasmodic effects from *comparatively* small doses.

Opiates should be administered as near the commencement of the attack as possible, and after the bowels have been thoroughly evacuated. They should also rather be given in the liquid than in the

[1] Op. cit., ii. 31.

solid form, for the reason just stated. From thirty to sixty minims of laudanum, or from half a grain to one grain of a salt of morphia in solution, may be directed at intervals of one or two hours, until some sensible impression is produced, or the necessity of augmenting the dose demonstrated. This should be first done by laudanum enemata, and by sprinkling morphia on the cutis, which ought by this time to be denuded over the upper half of the spinal column, or by its subcutaneous inoculation in the same region. If the medicine still show no tendency to exert a salutary influence, some other had better be tried. If we were obliged to say, with Dr. Thomson, that we "are not aware of any case on record cured by its means," the remarks now made would be superfluous, but there are numerous cases in which the free exhibition of opium, and counter-irritation to the spine, with, it may be, alcoholic stimuli, have cured this terrible malady.[1] Without attributing the sole credit to the opium in these instances, it formed undoubtedly the essential part of the treatment. A case is reported by Fick, of traumatic tetanus, in which repeated hypodermic injections of morphia, in doses not exceeding one-quarter of a grain, were followed by recovery.[2] Demarquay has recorded[3] two cases of traumatic tetanus cured by injections of morphia which were not merely subcutaneous, but which penetrated the tissue of the affected muscles, and were also made along the spine. It would seem that the muscular rigidity yields more readily under this method than when the narcotic is injected at an indifferent point. It is claimed that when the contracted masseters are directly injected, they promptly relax, even if temporarily, and enable the patient to take the necessary food.

In the somewhat analogous condition produced by *strychnia poisoning*, hypodermic injections of morphia have produced a prompt and salutary result.[4]

Neuralgia.—Opiates have at all times been employed to mitigate the pain of this disease, but they were seldom deemed adequate to its cure, until they began to be applied endermically. The discovery of morphia greatly facilitated this application. About a grain of the acetate or muriate of morphia diluted with powdered gum Arabic may be sprinkled upon a small surface, rapidly blistered by ammonia, or any other vesicant, over the origin or the most painful point of the affected nerve. M. Trousseau says that in superficial neuralgia so treated the pain rarely fails to be alleviated in a quarter of an hour, and he, as well as Dr. Blakiston, and M. Rougier, of Lyons,[5] who made extensive trials of the method, agree with nearly all observers that few even of the most inveterate cases of sciatica long resist this potent remedy applied in such a manner

[1] See Med. Observ. and Inquiries, vols. i. to v.; CURLING on Tenatus; and Dr. KIRKBRIDE's Clinical Reports, in Amer. Journ. of the Med. Sci., May, 1835; ibid., July, 1860, p. 281; Lancet, Jan. 1861, p. 59; Bull. de Thérap., lxiv. 309.

[2] Prager Vierteljahrs., ci. Anal. 100. [3] Bull. de Thérap., lxxxi. 299.

[4] Med. Times and Gaz., Sept. 1868, p. 336.

[5] Brit. and For. Med.-Chir. Rev., July, 1856, p 245; Bull. de Thérap., xxiv. 152.

as to maintain its influence for several successive days. It is natural to attribute the efficacy of this treatment entirely to the narcotic employed, nor would any doubt have been felt upon this point, had not M. Valleix undertaken to study separately the counter-irritant and anodyne elements involved. He showed clearly that in cases of neuralgia cured under the endermic application of morphia, the successful issue is chiefly due to vesication.[1]

The inconvenience of placing blisters upon the face, so often the seat of neuralgia, and their occasional tendency to leave behind them unsightly scars, may be avoided by a recourse to *inoculation.* This expedient was first suggested by M. Lafargue,[2] and is thus employed: A solution of about ten grains of the acetate or muriate of morphia in a fluidrachm of water or creasote is prepared, and a small quantity of it is introduced under the cuticle upon the point of a sharp lancet by three or four or more numerous punctures near the seat of pain. Over each puncture a small papule presently arises, which is soon afterwards surrounded by an areola of about half an inch in diameter, accompanied with some itching and heat. In an hour or two the redness entirely disappears; in twenty-four hours the papular elevation scarcely exists, and leaves no trace behind. The advantages of this method in neuralgia of the nerves around the orbit, and especially of those supplying the scalp, are too evident to require any comment. The constitutional influence of morphia is very readily and certainly produced in this manner, but its local effects are still more prompt and unequivocal. In many cases it affords instant relief, altogether removing pain which had been incessant and excruciating for several days; in nearly all it greatly mitigates suffering, even upon its first application, and usually requires but two or three repetitions to effect permanent cures even of the most inveterate forms of the disease. Instances are related by M. Lafargue, by M. Jaques, of Antwerp,[3] Mr. Rynd, of Dublin, and others,[4] of the speedy cure, by the morphia inoculation, of sciatica which had for months and even years, resisted all the agents which are commonly employed against this obstinate malady.

What has been said of the introduction of morphia into the substance of the skin is still more applicable to its use *hypodermically.* The effect of the narcotic is more prompt, and its influence upon the brain is more marked, so as to insure sleep at the same time that it palliates or neutralizes local suffering. As first employed by Dr. Wood in Edinburgh, and in this country by Dr. Ruppaner, of Boston, it was considered essential that it should be introduced as near as possible to the seat of pain. Mr. C. Hunter and others have shown that this restriction is generally unnecessary, and that its action is usually as prompt and certain into whatever part of the cellular tissue it is thrown. An effect not mentioned by all

[1] Traité des Nevralgies, Paris, 1841.
[2] Bull. Gén. de Thérap. (1836), xi. 328; xiii. 299; and July and Sept. 1847.
[3] Annuaire de Thérap., 1844.
[4] Dublin Med. Press, and RANKING's Abstract (Am. ed.), i. 29.

who have written concerning the remedy, is that it is very apt to excite nausea and even vomiting. Repetition of the injections is, however, in many cases, followed by the subsidence of these symptoms, which are, also, of secondary consequence when the pain which calls for the operation is very severe. And while it does not entirely prevent the nausea and vomiting which so frequently follow the administration of morphia by the stomach, it, on the whole, creates less tendency to that unpleasant consequence than when the ordinary mode of administration is used. A more than counterbalancing advantage consists in the continued efficacy of the medicine without an increase of the original dose, or with a much slighter increase than when it is administered by the stomach. Although the use of morphia in this or in any other manner must be regarded as usually palliative rather than curative, yet there are innumerable cases on record in which its anodyne effects have been permanent. A striking one is that reported by Dr. Ogle, in which a woman suffered from intense neuralgia in the left arm, forearm, and middle finger, following an abscess apparently the result of a blow at the middle of the arm. The continued disorder of innervation produced a hypertrophied, clubbed, and jagged appearance of the nail and end of the middle finger. After many months, during which subcutaneous injection of morphia was performed between forty and fifty times, the pain was subdued and the finger restored to its normal condition.[1] In a work on "*Sciatica, Lumbago, and Brachialgia*,"[2] is claimed for "the hypodermic injection of minute quantities of morphia" the honor of being "almost the only remedy for sciatica." So extravagant a pretension tends to discredit a very valuable remedy, and inspire doubts of the accuracy of the results which the author reports. The acetate is preferable to the other salts of morphia for subcutaneous injection, on account of its solubility in water. A solution of convenient strength is made with five grains of the acetate of morphia in one fluidrachm of distilled water, which will give about half a grain of the salt to every five drops of the solution.[3] This solution is solid at ordinary temperatures, and must therefore be warmed before being used. It is claimed for it that this circumstance is an advantage, inasmuch as it is said to prevent the decomposition which ordinary solutions promptly undergo.

Nervous Headache.—A cup of strong coffee containing from a quarter to half a grain of sulphate of morphia is one of the most efficient remedies for the severe hemicrania which females so often suffer at the catamenial periods. When the pain occurs independently of this cause, or in the male, the remedy is also successful in some instances, particularly if the stomach is not disordered.

[1] Times and Gaz., Nov. 1866, p. 474.

[2] By Henry Lawson, M.D., Lond. 1872.

[3] Wood, Month. Journ. of Med. Sci., Feb. 1855, p. 183; Hunter, Med. Times and Gaz., Oct. 1858, p. 409 and p. 457; Ibid., March, 1859, p. 234, etc.; Burns, Braith. Retros. (Am. ed.), xxxviii. 37. Mitchell, etc., Am. Journ. of Med. Sci., July, 1865, p. 67.

Diseases of the Respiratory Organs.—*Pain* and *cough* are the symptoms for which opium is most frequently prescribed in diseases of the chest. There are at least two forms of internal pain in thoracic affections, the one arising from serous inflammation, and excited by movements of the trunk and even by ordinary breathing; the other produced or aggravated by coughing, and apparently seated in the air-tubes, or in the attachments of the respiratory muscles. Of these, the former may, it is true, like any other pain, be palliated by opium, but it is much more certainly and speedily removed by depletion and revulsion; the latter, depending almost entirely upon the cough, is mitigated by whatever controls this symptom, and therefore by opium.

Coughing is an instinctive act intended, doubtless, to produce expectoration of the contents of the bronchia, but it is often excessive, more frequent and violent than is sufficient for this end, and sometimes, indeed, has that character when no bronchial secretion exists. By regulating it, therefore, the strength of the patient is preserved, and his comfort promoted. The proper dose of opium for allaying cough should always be less than is sufficient to produce sleep, unless, indeed, the patient is kept awake by other causes than coughing, and that not only because the hypnotic influence is superfluous, but because the constipation of the bowels, and the diminution of the bronchial secretion which opium causes, not unfrequently aggravate the oppression and increase the fever.

Although coughing in most cases requires to be moderated, yet in some, whatever interferes with the act is mischievous, and to this extent must be prohibited. Whenever the weakness of a patient prevents his expectorating freely, or when a superabundant secretion fills the bronchia, opiates increase the danger of suffocation by suspending or restraining the cough. Pituitous catarrh, an affection to which the old and feeble are peculiarly liable, and some cases of phthisis in the last stage, illustrate this remark. Bronchial affections of all sorts in old persons ought to be sparingly treated by opium, for, besides paralyzing the respiratory muscles, it diminishes the secretion of the pulmonary mucous membrane, and consequently renders it more tenacious, and difficult to expectorate.

At the very onset of an attack of *catarrh*, when the symptoms consist merely of some dryness of the nostrils, a little hoarseness, and horripilation, a grain of opium or an equivalent quantity of laudanum, or, still better, ten grains of Dover's powder, taken upon going to bed, along with a warm draught, will frequently succeed in cutting short the attack. This effect is due probably, to the stimulant and diaphoretic virtues of the drug, because the same result may often be obtained from a glass of hot lemonade or punch, without opium. It should be borne in mind that too large a dose, instead of dissipating the ailment, will only aggravate it, and produce a painful degree of oppression and constriction of the chest. This treatment, as well as the attendant caution, was first suggested

by Dr. Young as the result of his personal experience.[1] Dr. Moss, having suffered from *autumnal catarrh*, and had but slight relief from the internal use of morphia, used the same remedy hypodermically with immediate and lasting relief. He subsequently used it in a number of cases with almost invariable success.[2] In other acute affections of the lungs, opium is useful in the manner already pointed out, or as an adjuvant to antiphlogistic measures. Thus, in *pneumonia* and *pleurisy*, a full dose of opium is used to prolong the sedative effects of depletion, and to promote diaphoresis already favored by the loss of blood. In the former affection, also, it was formerly associated with tartar-emetic to facilitate the tolerance of this medicine when administered with a view to its sedative effects. In *chronic* affections of the lungs, the benefits of opium are almost entirely restricted to its palliative control over the bronchial secretion, the uneasy sensations which excite coughing, and the loss of sleep which it occasions. When the secretion is already scanty, and the cough annoying, opium should be administered along with ipecacuanha or squill, or in such other combination as will prevent its desiccative effects upon the bronchial mucous membrane. True *spasmodic asthma*, as was long ago pointed out by Whyte,[3] is very effectually moderated by a full dose of opium, which has not, however, any influence in preventing the return of the paroxysms. Numerous instances of immediate relief being obtained by means of hypodermic injections of morphia have been published. In this case the action of the remedy is clearly through the nervous system, and it seems not improbable that it allays the dyspnœa by relaxing the spasm of the respiratory muscles, as well as of the fibres which surround the bronchia.

Diseases of the Heart.—The prompt relief of pain afforded by the hypodermic injection of morphia doubtless led to its use in that most terrible of all pains, *angina pectoris*. Under its influence, and more speedily as well as for a longer time, than by any other treatment, the anguish abates and with it the tumultuous disturbance of the heart's rhythm. Dr. Clifford Allbutt and Mr. Teale have taken advantage of the soothing influence of this remedy, and the former eulogizes it in all forms of disordered action of the heart depending upon its organic disease, without regard to the swollen limbs, the agitation of the pulse, the congestion of the face, or the dyspnœa that may be present. Like digitalis, it is in cases of mitral regurgitation that it displays its greatest efficacy, rendering the violent and tumultuous action calm and regular. It is proper, because prudent, to begin with a minimum quantity. Dr. Allbutt recommends the muriate of morphia in doses varying from one-tenth to one-third of a grain, and finds that the average proper dose is about one-quarter of a grain. It does not need to be very

[1] Essay on Opium, sect. iii.
[2] Am. Journ. of Med. Sci., Jan. 1873, p. 275.
[3] Observations on the Nature, etc., of Nervous, Hypochondriac, or Hysteric Disorders, 2d ed., p. 491.

frequently repeated, not oftener, as a rule, than three or four times a week, provided that appropriate measures are employed in the interval to maintain the tranquillity which the morphia has established in the relations of the circulatory, respiratory, and other functions.[1] Dr. Greenhalgh is reported to have recommended vaginal suppositories of opium in cases of uncontrollable vomiting during *pregnancy*,[2] but subsequent publications upon this affection do not include opium among the available remedies for it. Mr. Johnston, surgeon of a "Cunard steamer," found the hypodermic injection of morphia the most efficient of all remedies in protracted *sea-sickness*. He used about one-eighth of a grain in each injection.[3]

Diseases of the Digestive Organs.—Pain, vomiting, and purging, with other disordered and injurious movements of the alimentary canal, and excessive secretions from its mucous membrane, are the morbid conditions of this organ, which opiates are adapted to correct. In the various diseases to be passed in review, they occur either singly or combined. *Vomiting*, dependent upon disorder of the stomach itself, and not upon the presence of irritating substances, or upon diseases elsewhere to which opium is inappropriate, can very generally be arrested by this agent. Even in gastric inflammation it may be employed after the inflammation has been partially subdued by general or local depletion, although the attack may have been owing to the action of irritant or corrosive poisons. These substances must of course be previously evacuated, and diluent and mucilaginous liquids in moderate quantities and at a low temperature, prescribed. But it is against vomiting excited sympathetically by disease of other abdominal viscera than the stomach, and in the uninflamed but morbidly sensitive states of this organ itself, that opium is most effectual, as in peritonitis, obstruction of the bowels, and certain forms of dyspepsia. Oftentimes it happens that the opiate is not long enough retained to produce its effects, in which case it may be introduced by the rectum, or by the endermic or hypodermic method.

Gastralgia.—Neuralgia of the stomach is generally described as a symptom of dyspepsia, or as by Cullen under the name of pyrosis, or water-brash. By this physician and by Chapman it was attributed to debility of the stomach, arising from a meagre and penurious mode of living, and by others, to an exclusively vegetable diet, as of oatmeal, or the brown bread, which the continental peasantry of Europe chiefly consume. Amongst ourselves the substitution of tea and coffee for animal food is a fruitful source of this painful and alarming disorder. As Dr. Chapman remarks, cases of painful dyspepsia are often met with among the wealthy and luxurious. It in fact depends upon general nervous disturbance, as well as upon local causes of indigestion, and is a frequent complication of hysteria, hypochondriasis, exhaustion by bodily or mental fatigue, sensual excesses, depressing emotions of the mind, and that state of

[1] Practitioner, iii. 342. [2] Bull. de Thér., lxxv. 234.
[3] Med. Times and Gaz., April, 1869, p. 381.

nervous excitability which anæmia, chlorosis, and even pregnancy, sometimes generate. But, whatever may be its cause, opiates are equally important in its cure, the salutary effects of the drug being of course greater or less in proportion to the more or less simple and uncomplicated nature of the attack.

The pain and vomiting, which are the prominent symptoms of gastralgia, are usually excited by the presence of food in the stomach, and come on at variable periods after meals. In the less severe cases, a small quantity of opium, as one-quarter of a grain, taken immediately before eating, will generally prevent the attack; or a solution of acetate of morphia, one grain to the ounce of sweetened water, may be taken in teaspoonful doses on the first sensation of pain, and continued at intervals of ten minutes until some effect is produced. When the disease is more violent, the dose must be augmented in the same degree, and, if the pain is prolonged, morphia should be introduced through the epigastrium.[1] It must not be forgotten that gastric pain is only one symptom of the disease in many cases, and that a more wholesome diet, exercise, excitants of the skin, quinine, iron, bismuth, and above all mental diversion, are requisite to confirm the cure.

M. Bouchardat[2] furnishes an explanation of the *modus operandi* of opium in this disease, which, if not applicable to all cases, is at least ingenious. He attributes all the symptoms to an excess of the gastric juice, which fluid he alleges to have but a small share in the digestion of vegetable substances, and which thus, on reaching the duodenum, neutralizes the pancreatic juice and prevents the digestion of amylaceous matters. Opium, according to this author, diminishes the secretion of gastric juice, and of course prevents the mischief which results from its excessive quantity. It is a sufficient disproval of this, as an exclusive theory, that in not a few cases of gastralgia the fluid rejected from the stomach is quite insipid.

Diarrhœa.—Of acute attacks of diarrhœa there are two principal varieties, in which perhaps opiates are not equally appropriate; in the first there is an excessive secretion of fluids into the intestine, arising from the impression of cold upon the cutaneous surface, and in the second undigested food or some other irritant provokes an increased action of the bowels. As a general rule, the former may be successfully combated by opiates alone, while the latter more commonly requires that the irritating substances be previously evacuated by a laxative. The presence of undigested food in the dejections is not always, however, a contraindication to opium; in the chronic forms of diarrhœa, this circumstance is due to the morbid irritability of the bowels, which hurry the aliment through them without its being assimilated. This condition, as much as any other, demands imperatively the use of opium for its cure.

[1] Sandras, Bull. de Thérap., xxiii. 84; Valleix, ibid., xxvii. 31; Saint Martin, ibid., xxxvii. 78.

[2] Annuaire, etc., 1846, p. 7.

Even where the cause of diarrhœa is beyond the reach of opiates, these agents are still beneficial in moderating the discharge, as in the colliquative flux of phthisis. In such cases enemata of laudanum and the hypodermic use of morphia, are, in general, preferable to opiates given by the mouth, which are more apt to enfeeble the digestion. If they have not this effect, they should be combined with astringents, and of such combinations none is superior to opium and acetate of lead. In the chronic forms of diarrhœa which are independent of constitutional disease, many authorities regard a combination of calomel with opium as superior to that just mentioned. Eberle states that he has repeatedly put a permanent stop to chronic discharges from the bowels by exhibiting a quarter of a grain of opium, with one-eighth of a grain of calomel, every four hours. This treatment is peculiarly appropriate to chronic forms of the affection next to be considered.

Dysentery.—It would be a fruitless labor to attempt to judge of the value of opium, and the method of employing it in dysentery, from what has been written on these subjects, were no reference made to the forms of which the disease is susceptible. Some authors have founded their opinion upon the effects of opium in sporadic dysentery, and the greater number upon their experience with this agent in various epidemics of the disease, many of which differed in type as widely as others in geographical position, as far, indeed, as the East is from the West. Thus, while Dr. Christison[1] declares that severe epidemic dysentery may be cut short in the early stage by opium, given boldly and often, and Dr. Chapman[2] says that, deprived of the aid of opium, he should really not know how to proceed in the treatment of the disease; Cullen[3] maintains that, "notwithstanding the urgency of the pain, it is at best a very precarious remedy, and to be avoided as much as possible;" and Twining, mingling theory and experience, remarks: "When we remember the actual condition of the local disease which is to be cured before we can remove acute dysentery, we shall hold opiates in great contempt. I have very often seen opium exceedingly injurious by masking the most deadly symptoms until the patient was past recovery."[4]

Nothing can be plainer than that these authors must have observed and treated dysentery under such opposite circumstances as to prevent their results from being comparable with one another. Baillou,[5] and after him Sydenham, dwell upon the error of applying one treatment to all epidemics of dysentery, yet the authority of the latter is constantly appealed to in favor of an opiate treatment which he never prescribed. Before his time the treatment of the active stage of the disease was composed of evacuants, and in its

[1] Month. Journ. of Med. Sci., i. 90. [2] Op. cit., ii. 179. [3] Op. cit.
[4] The Diseases of Bengal (Calcutta, 1832), p. 16.
[5] "Prout variæ sunt dysenteriæ, ita variare remedia opportet. Nec, quemadmodum multi faciunt, quasi eumdem soccum et cothurnum omnibus aptantes oportet eodem modo curare omnes dysenterias a quacumque causa ortæ sint."—Ballonii, Op. Omn., tom. iii. p. 215.

decline astringents were administered, with an occasional dose of some opiate preparation by the mouth or rectum. Sydenham established the more methodical plan of using evacuants and opiates on alternate days, and depended upon the latter exclusively in mild sporadic cases. His reasoning, like that of nearly all physicians both before and since, was, that the contents of the bowel must first be removed, lest the anodyne should augment the evil by retaining them. Hence, whether with Zimmerman,[1] Young,[2] Pemberton,[3] Eberle,[4] Thompson,[5] and the great majority of experienced writers upon dysentery, the primary dependence is placed upon laxatives, or whether, with Moseley, emetics and sudorifics are preferred, opiates are nevertheless indispensable for allaying tormina and tenesmus, promoting sleep, and favoring the action of the skin. "The real use of opium," says the author last mentioned, "is to arrest the hurry of the disease: to procure time to put some rational method of cure into execution, to take off the irritating property of other medicines, and to give them their intended effect."[6] Annesley, having the same object in view, prescribed large doses of opium with calomel in the forming stage of the disease, and as long as feculent matter appeared in the stools, and afterwards opiate enemata.[7]

In mild attacks of dysentery there is no doubt that opium alone, or that purging alone, will effect a cure, but it is equally certain that rest, diet, diluent drinks, and emollient clysters will have the same effect; but, when the disease is severe, no exclusive plan can be relied upon, and least of all, perhaps, that by opium. The violence of the malady must be broken by emetics, laxatives, or diaphoretics, according to the type assumed by the case under treatment, and the epidemic constitution, after which, or alternating with which remedies, the "matchless power of opium" may be invoked for perfecting the cure. Even under these circumstances we would follow the advice of Pringle, and prescribe opiates at first in small doses, a quarter or half grain every three hours, or a corresponding dose of laudanum by injection. This, it will be understood, is in addition to the portion of laudanum which it is proper to add to each dose of purgative medicine administered, in order to prevent its griping. In the more advanced stages of dysentery, when the affection has become stationary, or tends to pass into the chronic form, opiates are not less valuable than before, and are most effectually given in combination with astringents, or, as before stated, in conjunction with small doses of calomel.

Chronic dysentery is materially benefited by opiates. They moderate the action of the intestinal canal, reducing the number of dejections, alleviating pain, preventing the food from passing too rapidly through the bowels, and at the same time prolonging

[1] Traité de la Dysenterie, chap. vi. [2] Op. cit., p. 50.
[3] Diseases of the Abdominal Viscera (London, 1820), p. 146.
[4] Loc. cit. [5] Ibid.
[6] A Treatise on Tropical Diseases, 4th ed. (London, 1803), p. 257.
[7] Diseases of India (London, 1828), ii. 272, etc.

the contact of the astringent, balsamic, or other similar agents employed to modify the diseased surface of the intestine. Hence opium, without being essentially curative in chronic dysentery, is invaluable as an adjuvant to other remedies.

Cholera-morbus and Cholera.—In the *sporadic* form of this disease (cholera-morbus), no other remedy resembles or even approaches opium in efficacy. It was formerly thought necessary to precede its administration by a free evacuation of the stomach and bowels; for the vomiting and purging which belong to the disease were held to be evidences of a salutary effort on the part of nature, which it was the duty of the physician to encourage. But a truer observation taught that these operations, instead of being critical, are essentially morbid, and experience demonstrated that the speediest method of arresting them is the most direct road to the patient's cure. It is now very generally admitted that opium affords the surest means of gaining this object. A grain should be taken every hour, or every half hour in severe cases, and the patient, meanwhile, prevented, as far as possible, from drinking. Enemata should also be administered, containing from twenty to forty drops of laudanum. Or, if the thirst cannot be allayed by rinsing the mouth and throat, small quantities of iced water or lemonade, or fragments of ice, may be swallowed. But the patient should understand that the rapidity of the cure depends in a great measure upon his firmness in resisting his instinctive craving for fluids.

At whatever stage the affection may be, there is an equal propriety in administering opiates. Should the vomiting and purging be so incessant as to cause the rejection of the opiates prescribed, morphia should be administered hypodermically.[1] In cholera-morbus, however, although opium is truly curative, and beyond all price as an alleviator of pain, it cannot be said, in all cases, to constitute a necessary part of the treatment, for the disease is very rarely fatal when it attacks persons in good health. Under these circumstances, the urgency of prescribing opium is not great enough to outweigh any important contra-indications to its employment that may exist. When the constitution is naturally feeble or impaired by previous disease, the remedy is more important, since it may then become necessary for the preservation of life.

In *epidemic cholera* the efficiency of opium is no better established than that of the greater number of remedies employed against this fatal malady. There is no evidence whatever that it is beneficial in very severe cases, and scarcely any of the manner in which it exerts its influence upon those of a milder type, of what symptoms it palliates, or how far it shortens the duration of the disease. Unquestionably opium has prevented the development of many a case of Asiatic cholera, by subduing those premonitory symptoms which have received the name of *cholerine;* for this purpose, indeed, its value is very great, yet not so much so as to exceed that of

[1] Compendium de Médecine Pratique, par MM. De la Berge et Monneret. Paris, 1837, ii. 234.

camphor with aromatic and diffusible stimulants, and mild astringents. If the records of treatment in the fully formed stages of cholera are examined, it will be found that opium was depended on in a very small number of cases indeed ; that so far from being administered in larger quantities than are given in the sporadic affection, as might have been expected from the superior gravity of the epidemic disease, it was actually prescribed in fractional doses, and associated with more active medicines; and that, for anything that appears to the contrary, it might have been safely omitted from the treatment of the graver forms of Asiatic cholera.

All experienced physicians of adequate authority agree in dissuading from the use of opium in the active stages of *cholera infantum.* It is not logical to ground this advice, with Eberle, upon the "strong tendency to cephalic affection" which characterizes the disease; the objection to opium rests upon the much more solid foundation of direct experience, and the young practitioner ought to acknowledge its force, when he feels tempted by the vomiting and purging of his infant patients to prescribe for them a remedy which is so efficient in relieving analogous symptoms in the sporadic cholera of adults. Dr. Hallowell, of this city, who has furnished by far the most complete history of the disease in question, confirms the opinions of Dewees, Drs. Condie, J. F. Meigs, and others, and recommends extreme caution in the use of opiates in the first, and, indeed, all stages of cholera infantum.[1] If used at all, opium should be given in the form of Dover's powder, and in the dose of a quarter or a half grain, with an equal quantity of calomel, every three or four hours. In the chronic form of the affection opiates are more appropriate, and are then most advantageously associated with mild astringents. The efficacy of opium in the first, and its want of curative power in the other two forms of cholera now mentioned, lend a strong support to the opinion which rests also upon other grounds, that in the latter there is an additional morbid element which, in spite of a similarity of symptoms, creates an essential distinction between them and sporadic cholera morbus.

Colic.—This term does not properly designate a disease, but the symptom of griping pain merely, which is common to several distinct affections; to that condition which precedes diarrhœa occasioned either by cold or by acerb fruits, or sour drinks; to those several forms, so different in gravity, of obstruction to the bowels by simple constipation, by stricture, by invagination, and by hernia; to the painful passage of a gall-stone through the excretory ducts of the liver; and even, according to general usage, to a like impediment in the ureter. Still another variety of colic, that of painters, may be added to the preceding, although, by most medical writers at least, it is described as an independent disease. In affections so different in nature and gravity, it is plain that the efficacy of opium must be extremely various, even in relation to the element pain which is a prominent symptom in all of them.

[1] Am. Journ. of Med. Sci., xiv. 46.

Here, as elsewhere, the treatment cannot be rational while the diagnosis is obscure, and the extent to which opium may be used to alleviate pain in such affections depends upon how far it is likely to interfere with the other means employed with a more direct aim at removing the cause of suffering. In attacks depending upon acrid ingesta or fæcal accumulations, they may be prescribed along with, or even before, cathartics; in painters' colic they should alternate with purgatives; and when the attack arises from cold, or from the passage of a biliary or renal calculus, they may be given alone. In each case the dose must, of course, be proportioned to the violence of the pain. Testimony is not wanting to prove that in painters' colic opiates may be depended upon almost exclusively for curing the disease. Dr. Luckey reported, many years ago, that he was in the habit of prescribing ten grains of opium every hour until forty grains were taken, and with such effect that a mild laxative was then sufficient to open the bowels. This heroic treatment is vouched for by Eberle as having been literally and very successfully employed.[1] When the source of the symptoms is mechanical displacement of a portion of the intestine (invagination, hernia), no good purpose can be answered by larger doses than are just sufficient to mitigate suffering and moderate peristalsis; in external strangulated hernia, mischief may arise from producing a full narcotic effect, for the patient may appear to be at ease while the strictured bowel is becoming gangrenous. Cases illustrative of this unfortunate occurrence have been reported by Dr. Watson and Dr. Buck, of New York.[2]

Peritonitis.—Dr. Graves, of Dublin, it is believed, was the first person to show the curative powers of opium in peritonitis produced by the operation of paracentesis. He was led to employ this agent as a sedative in large doses, because the patients operated upon were too feeble to bear depletion. Subsequently, he cured by the same means an attack of peritonitis excited by the opening of an hepatic abscess. In another instance a boy with *enteritis* was suddenly seized with symptoms of peritoneal inflammation, which were subdued by large doses of opium. The ensuing constipation was treated by exhibiting an aperient, when the symptoms returned, and the patient died. A small perforation was found in the cæcum, and the intestines were agglutinated in the left iliac fossa. On a subsequent occasion a man who had taken an overdose of Glauber's salts presented the signs of peritoneal inflammation; he was in like manner treated with opium, and recovered.[3] Dr. Griffin, of Limerick, relates one case of alleged peritonitis from intestinal perforation, in which a girl had gorged herself with gooseberries and currants, and another, of a boy who was only seen "in the last stage of typhus fever." Of the latter, Dr. Griffin cautiously remarks, "the symptoms seemed in a degree to indicate perforation," and again, the suspicion of perforation having occurred

[1] Elem. of Therap., p. 337. [2] N. Y. Journ. of Med., Nov. 1844.
[3] Med.-Chir. Rev., xxviii. 541, and xxxv. 157.

would appear somewhat probable."[1] Both patients were rescued from the very grasp of death by large doses of opium.

None of these cases, it will be observed, is an unequivocal example of intestinal perforation in typhoid fever; but several of them demonstrate the marvellous powers of opium in arresting peritonitis from division of the abdominal serous membrane, and its control over the symptoms of that disease in certain other dangerous conditions. Very few instances, indeed, are on record in which the signs of perforation in an undoubted case of typhoid fever disappeared under the use of opiates. One is recorded by Louis.[2] Instead, however, of giving, like Drs. Graves and Stokes, a grain of opium every hour, he obtained his object by administering a grain and a half of muriate of morphia in the course of every twenty-four hours. Such caution is not, however, essential, for the first-named gentlemen expressly state that their large doses gave rise to no unpleasant effects. Several examples similar to this one might be adduced, in all of which there was a strong presumption of peritonitis produced by perforation of the bowel. But as it is now certain that peritonitis may occur as a complication of typhoid fever merely by an extension of inflammation from the intestine, without perforation of its coats, the precise degree of usefulness of opium in such cases is still undetermined.[3]

The preceding remarks are intended to show that the success usually ascribed to opium in peritonitis from intestinal perforation is somewhat exaggerated; but they at the same time prove conclusively its value in at least analogous conditions, and therefore encourage its use in other forms of peritonitis, and enjoin it peremptorily in that which has hitherto resisted every other plan of treatment. Its curative action under the circumstances we are considering is, doubtless, owing to its retarding the peristaltic movements of the intestines, and its influence ought therefore to be promoted by the patient's remaining perfectly still, and living upon the least possible amount of food.

Opium has been employed by many practitioners in *puerperal peritonitis* as an adjuvant to depletion and mercurials, but it was originally proposed in 1843, and has more recently been advocated by Dr. Alonzo Clark as an exclusive remedy in this disease. Dr. C. is careful to distinguish the cases in which it is indicated from those in which the leading element is purulent metritis. In the latter, however, it is believed in some degree to control the inflammatory element. According to Dr. C. this is the most efficacious medicine that has yet been proposed for puerperal peritonitis. But, in order to obtain its curative effects, its use must be commenced early, and the patient brought under its influence as rapidly as the

[1] Med. and Phys. Problems, p. 20.

[2] Fièvre Typhoïde, 2ème éd., ii. 449. M. Louis admits that the character he assigns to this case is only in the highest degree probable, not absolutely certain.

[3] Compare Phil. Med. Exam., N. S., x. 120; N. Y. Journ. of Med., N. S., ii. 330; Transactions of the College of Physicians of Philadelphia, N. S., ii. 338, 351.

susceptibility of his system can be ascertained by trial. "The tolerance of opium," says Dr. Clark, "in some cases of puerperal peritonitis, almost surpasses belief. Yet in private practice I have not found more than half or two-thirds of a grain of sulphate of morphia every two hours necessary." "The influence of the opium," it is added, "should be kept up till the pain and tenderness subside, the tympanitis diminishes in some degree, and the pulse falls below 100; then, with the concurrence of other symptoms, it should be gradually diminished, and at length discontinued."[1] The value of this method is still undetermined, for, as far as we can learn, the example of its sagacious proposer has not yet been imitated. The general impression appears to correspond with that expressed by Richter many years ago, that nearly all observers agree in regarding puerperal peritonitis as a disease requiring great circumspection in the use of opiates.[2]

Diseases of the Genito-Urinary Organs.—The utility of opium in large doses in relieving *nephritic colic* has already been spoken of; it is not less useful when calculi exist in the pelvis of the kidney or the bladder, or when chronic catarrh is the cause of pain. In *spasm of the urethra* it is, next to the warm bath, the most efficient remedy; combined with camphor, it diminishes the severity of gonorrhœal *chordee*, or prevents this painful accident, especially when used hypodermically; it palliates the scalding of the urine and the burning pain of inflammation of the urethra and vagina; no other remedy, except the anæsthetics, so well allays the exhausting "grinding pains" which frequently precede labor, and none so effectually prevents threatening *abortion* when it depends upon any cause which does not render the premature expulsion of the ovum inevitable. Perhaps the most common accidental cause of miscarriage is over-exertion; and its effects can nearly always be prevented by the timely and liberal use of opiates. In the cases now mentioned, hypodermic injection is preferable to any other means of introducing opium into the system; it brings the remedy near to the seat of the disease, and spares the stomach much of that disorder which it is apt to occasion when opium is taken by the mouth. The amount proper to be given can only be measured by the effects produced, which are very dissimilar in different persons. It is well to commence with a dose of a quarter of a grain of morphia, and repeat it from hour to hour until the narcotic influence is well developed or relief is experienced.

Venereal Disorders.—The preparations of opium have long been used to a greater or less extent for palliating the pains of secondary syphilis, but it was reserved for Mr. Grant, an English army surgeon in New York, and Michaelis, physician of the Hessian mercenaries employed by the British during our war of independence, to propose this medicine as a specific for syphilis, and for a time to bring over to their opinion a number of practitioners in Europe and

[1] N. Y. Journ. of Med., March, 1855, p. 304, and Jan. 1858, p. 82.
[2] Ausfürliche Arzneim., ii. 639.

in this country. The practice was to give a grain of opium morning and night, increasing each dose daily by one grain until the symptoms abated. These doses generally procured copious diaphoresis, and relief from pain. But the comparative experiments of Pearson,[1] and the trials of John Hunter,[2] showed conclusively that the anti-syphilitic virtues attributed to opium are quite illusory. In one case, Hunter administered seven hundred and sixty-eight grains of opium in twenty-six days. Before the publication of the American views, he had been in the habit of employing opium with great advantage as a local application to primary and secondary sores, and as an internal remedy to persons affected by them. The latter method is now very frequently pursued when the pains in the bones are violent, or the patient is of a nervous temperament. "In primary syphilis opium is an important adjuvant to mercury, especially in females and other excitable persons, but it should in no case be regarded in any other light than as a sedative and palliative, and ought not to be permitted to usurp the place of those true anti-venereal remedies whose character has been established by the experience of ages."[3]

According to Dr. Chapman,[4] it was the practice of the late Dr. Kuhn to treat *gonorrhœa* exclusively by a grain of opium morning and night, a plan which he found, on the whole, more successful than any other in managing this troublesome complaint. Dr. Lyons, of Philadelphia, is also said to have cured an obstinate and severe gonorrhœa by opium alone.[5] So far as we know, these are the only practitioners who have attempted so simple a cure of gonorrhœa, and the fact is mentioned for the purpose of inducing others to give it a sufficient trial.

Diabetes.—Opium is superior to any other single medicine in diminishing the quantity and the saccharine quality of the urine in this disease, and it has entered more or less into the treatment prescribed for diabetes by Aetius, Sydenham, Willis, Darwin, and, in our own time, by Rollo, Bardsley, Warren, Prout, Elliotson, and others. By most of these physicians it was associated with astringents, and since the experiments of Rollo, with an almost exclusively animal diet. The efficacy of opium in diabetes appears to depend upon its being administered in full and progressively increasing doses until a partial tolerance of the drug is produced. Under these circumstances there can be no doubt that it frequently appeases the hunger and thirst which are so tormenting in this disease; that under its influence a smaller amount of urine and less charged with sugar is secreted; that the skin becomes more pliant; and that, consequently, the flesh and strength are less rapidly wasted, while the mind yields less readily to despondency.

Dr. Ferriar, who employed opium in conjunction with cinchona, uva ursi, lime-water, and animal diet, states that out of thirteen

[1] DUNCAN'S Med. Commentaries, xvi. 217.
[2] HUNTER on the Venereal. Complete Works, Am. ed., p. 308.
[3] LAGNEAU, Traité prat. des Mal. Syphil.
[4] Op. cit. [5] DUNCAN'S Med. Com., x. 154.

cases of which he had preserved the minutes, ten were cured, and two much relieved.[1] On examining the thirteen cases reported as examples of diabetes mellitus, in Dr. Ferriar's medical histories, the degree of success claimed by him appears to be singularly exaggerated. There is only one case out of the thirteen which gives unequivocal evidence of its cure, for the subject of it is reported as being in good health four years after he had been under treatment. Yet, even of this case, it is not explicitly stated that the urine was saccharine. Out of seven of the remaining cases, two are said to have relapsed, two are reported as having died while under treatment, two as improved, and one as not improved. It is evident that Dr. Ferriar's statement was made without any direct reference to the written record, and like most others of similar origin, was very wide of the truth. In 1837 McGregor revived this practice, and reported two cases which apparently recovered under the use of opium, gradually increased until sixty grains a day were taken by one of the patients, and ninety grains by the other, without narcotism. On discontinuing the medicine the disease revived and the patients died. In 1868 Dr. Pavy published several cases in which opium, in doses of from three to twelve grains and even more a day, caused a great reduction in the amount of urine voided and the complete disappearance of sugar from that secretion, while the patients' weight increased and their general condition improved.[2] Dr. Sanderson[3] has reported a case in which the opiate treatment was attended with a marked diminution in the quantity of urine and of sugar; and Dr. Thompson[4] one in which the improvement did not begin until some time after the opium had been omitted. On the whole, it may be concluded, in the light of this testimony and from our own observation, that opium is a valuable adjuvant in the treatment of diabetes, provided the dietetic and gymnastic regimen is duly carried out, in diminishing the excretion of sugar and the waste of tissue it represents, as well as in holding distressing nervous symptoms in abeyance.

Diseases of the Organs of Locomotion. Rheumatism.—Muscular rheumatism may sometimes be cut short by a full dose of opium administered soon after its invasion, or, still better, by a corresponding quantity of Dover's powder. These remedies act by producing copious diaphoresis. In acute articular rheumatism, it has generally been used to allay pain, but in 1839, Dr. Corrigan, of Dublin, communicated the very favorable results he had obtained by employing opium in this disease, as an almost exclusive remedy, and in very large doses.[5] He regarded the practice commonly pursued of giving a grain of opium every fourth or sixth hour, as quite inefficient, and as rather injurious than otherwise, by its stimulating influence. To produce a decidedly sedative and curative effect, he held that a grain of opium must be given every hour or

[1] Medical Histories and Reflections (Phil. 1816), p. 453.
[2] Trans. of the Clinical Soc. of London, ii. 44.
[3] Ibid., p. 163.
[4] Ibid., lv. 153.
[5] Med.-Chir. Rev., Jan. 1840.

two until the patient feels relief, and the impression should then be maintained at the same point throughout the attack. Under these circumstances, according to Dr. Corrigan, it neither disturbs the brain nor confines the bowels, but lessens the patient's suffering, husbands his strength, shortens the disease, and prevents complications about the heart. These recommendations are very strong, and if they had been sustained by the further observation of Dr. Corrigan and of other physicians, ought to have influenced and modified the customary plan of treating acute rheumatism.

Eberle advocates large doses of opium in inflammatory diseases, as less stimulant than small ones, and says that in rheumatism he has, after proper depletion, given as much as four and five grains for a dose, and with most favorable results,[1] but it does not appear that he sustained the opiate impression throughout the attack. He also, in another work, quotes Cazenave as saying, that the timidity with which this narcotic is usually administered in acute rheumatism, is the cause of its frequent failure in doing conspicuous good, and as recommending a grain of opium to be given every hour, "till a complete calm is established, or an abundant perspiration induced."[2] Dr. Christison regards bleeding as an essential preliminary to the opiate treatment in acute inflammatory rheumatism. But, it may be remarked, he administers opium in the form of Dover's powder, given in ten grain doses every half hour until half a drachm is taken, so as to produce a copious diaphoresis, which is to be kept up for thirty-six or forty-eight hours, by means of warm drinks. This is a somewhat different procedure from that which has been considered, and to be successful, doubtless requires that the opiate should follow depletion.[3] Continued experience has not confirmed the impression which the reports of Corrigan tended at first to make. It has, on the contrary, shown that, however opium may relieve pain, it, in doing so, merely masks a symptom of the disease, while it tends to prolong the attack, and to increase the liability to cardiac complications. In 1869 the opinions of the leading Irish physicians on the treatment of acute rheumatism were collected and published,[4] and among them there is not one which favors either an exclusive treatment of the disease by opium, or its use at all except as a palliative. Originally, impressed with the views of its proposer, we were in the habit of employing it in large and repeated doses, but at length became convinced that its effects were such as have been stated above, and that its proper place in the treatment of acute articular rheumatism is that of an anodyne and soporific, allaying suffering and promoting sleep, and thereby husbanding the patient's strength while the disease is removed by eliminative medicines.

Trousseau and Bonnet presented an interesting narrative of

[1] Op. cit., p. 329.

[2] Practice of Medicine (Phil. 1831), vol. i. p. 378. The date of this statement, it will be observed, is several years anterior to that of Dr. Corrigan's report.

[3] Edin. Month. Journ., Feb. 1841.

[4] Dublin Quart. Journ., May, 1869, p. 431.

the treatment of articular rheumatism by the endermic application of the salts of morphia.[1] They produced small blisters with ammonia over every affected joint, and dressed them twice a day with muriate of morphia. Their observation led them to conclude that the influence of these remedies was chiefly local, for while they relieved the pain, in acute rheumatism, they did not prevent the disease from migrating from joint to joint. Cases in which it was more fixed in one or several articulations, and had passed the inflammatory stage, were found to be more amenable to the endermic treatment.

Gout.—It is pretty well agreed among practitioners of the present day, that the pain attendant on a fit of the gout may, and ought to be, modified by opium, prescribed as a palliative merely, and not at all to supersede remedies which influence more directly the violence and the duration of the disease. To lessen the anguish of gout, however, opium must be given on the approach of the paroxysm, in doses quite as large as were recommended for acute rheumatism, and repeated at even shorter intervals. Scudamore strongly recommends this treatment, and strikingly illustrates its utility. The wine and vinegar of opium are, perhaps, preferable to the solid drug, in consequence of the aromatic ingredients they both contain. In *retrocedent gout* attacking the stomach, opinions in favor of opiates are still more unanimous. They can, indeed, be hardly dispensed with, and must be given boldly and often. The liquid preparations just mentioned should be administered every half hour in the dose of sixty drops of the former, or thirty of the latter, as minimum quantities, to be rapidly increased if the urgency of the symptoms demands it; or equivalent quantities of morphia should be used hypodermically. At the same time the patient should be plied with diffusible stimulants, which will promote the object in view, and permit a reduction in the dose of the opiate, as well as its earlier suspension.

As a Local Remedy.—Several of the more important examples of the local uses of opium have already been pointed out, under the head of neuralgia, tetanus, rheumatism, etc.; it may now be added that liniments and poultices, containing opium or its preparations, are in constant use as local anodynes, although their efficacy is much inferior to that of the salts of morphia applied to the denuded cutis, or used according to the hypodermic method. As a dressing to irritable and unhealthy *ulcers*, a watery solution of opium is soothing; in granular *conjunctivitis*, with or without ulceration of the cornea, the wine of opium may be used with advantage; in *earache*, a few drops of laudanum mixed with warm sweet oil, may be introduced into the auditory meatus; in *toothache*, from caries, the pain is often palliated by a strong solution of a salt of morphia on a morsel of cotton placed in the cavity, and in other forms of odontalgia frictions of the gum at the affected part, with any concentrated opiate preparation, its inoculation by numerous

[1] Archives Générales de Médecine, tom. xxvii. and xxviii.

punctures, still better, the injection of a solution of a salt of morphia into the tissue of the gum, will frequently be followed by an entire relief from suffering. In *paronychia*, an affection second to none for severity of pain, it is highly probable that this very symptom tends to augment the vascular injection of the part, and the degree of suppuration which follows. It is, at all events, certain, that when attacked in the forming stage with strong opiate fomentations applied without intermission, the further progress of the affection is often completely checked, and a resort to the knife, which is so justly dreaded by the sufferer, averted.

Antidotes.—As opium and its preparations produce narcotism in so far only as they are absorbed, and as no chemical reagent is known by means of which the active principles of the narcotic can with certainty be rendered insoluble in the stomach, there remain no other modes of procedure, when a poisonous dose of opium has been swallowed, than to remove it from the stomach, and then, if its constitutional effects appear, to combat them by means of stimulants or antidotes addressed to the nervous system. The primary indication which has been mentioned is often difficult of fulfilment, for the nervous system is already benumbed when medical aid is sought, and the emetics which operate by direct contact with the extremities of the nerves concerned in the act of vomiting, no longer produce this result, or only the more powerful among them, and in very large doses. In mild cases, and when the drug has been very recently taken, a dose of ipecacuanha will generally suffice to procure its rejection, or copious draughts of tepid water containing mustard or salt may answer the same purpose. If these fail, sulphate of zinc, in doses of from one to two scruples, should be given, and, if the stomach still refuse to act, ten or fifteen grains of sulphate of copper may be administered. Dr. Beck[1] observes that sulphate of copper and tartar-emetic are not always safe remedies in narcotic poisoning, for, if retained in the stomach, they may themselves produce dangerons inflammation of the digestive tube. This objection is not valid as regards sulphate of copper; in the case of tartar-emetic its sedative operation is so powerful that it should be excluded from the ordinary treatment of narcotic poisoning.

Dr. Thompson objects to the practice of administering diluent drinks as dangerous, in consequence of their spreading the narcotic poison over a larger surface, and thus promoting its absorption. This opinion, which does not appear to be deduced from any observation of the bad consequences of the method, may be met by the argument that whatever mischief the fluid tends to cause by diffusing the poison is probably counterbalanced by the corresponding diffusion of the emetic substance, which thus acts more promptly and less painfully. The emetic action may be favored by tickling the fauces with a feather, or with the finger, as well as by the several means adapted to arouse sensibility, which will presently

[1] Med. Jurisprudence, ii. 586.

be pointed out. Enemata containing about a scruple of tartar-emetic have occasionally succeeded in procuring emesis, when medicines given by the mouth have failed to do so, or when the patient has obstinately refused to take them.[1] The clysters should be very large and introduced as high as possible into the bowel, by means of an œsophagus tube. Tartar-emetic, in the dose of one grain, and dissolved in water or whey, has been successful in producing emesis on being injected into a vein of the arm, after all other means of attaining this object had proved ineffectual.

Although, as before remarked, there is no specific antidote to the preparations of opium, yet when a large quantity of the poison has been swallowed, it may be well to administer the *ioduretted water* of Bouchardat,[2] which is composed of one grain of iodine, two of iodide of potassium, and a pint of water. A solution of tannin has also been proposed with a view of precipitating the active principles of the poison, but we are not aware of its ever having been employed.

If the means now recommended do not cause free vomiting, or the stupor is so profound as to prevent their use, the *stomach-pump* should be resorted to without delay, and the stomach so thoroughly cleansed with warm water that what is withdrawn gives no evidence of foreign intermixture of any kind. But when opium has been swallowed in mass, the attempts to produce emesis should be renewed after a sufficient trial has been given to the stomach-pump.

After the foregoing measures have all been faithfully employed, the constitutional effects of the opiate remain to be combated, and with a vigor proportioned to the want of success which has attended the previous treatment, as well as to the degree of narcotism present. The remedies for this state all consist of stimulants of the nervous system, acting either directly upon its great centres, or indirectly by exciting the respiratory function. Some of them are applied internally, and others externally. Of the former, the best, and indeed the only one which merits confidence, is *coffee*. It should be made strong, and given with little or no sugar, which, according to Bouchardat, delays its absorption and lessens its power. This author advises that a small quantity of brandy be added to each dose.[3] Dr. Fosgate, of New York, who accidentally took an overdose of morphia, and was tormented with nausea, retching, and oppression of all his faculties, describes the effect of cold strong coffee as a speedy relief of all these symptoms, and the induction of a state of delightful reverie, which was followed by sound sleep.[4] Even in desperate cases this remedy has proved effectual. One is related in which more than ten grains of acetate of morphia were taken, and although three hours elapsed before the coffee was administered, and the patient was then comatose, yet he recovered.[5] Another is recorded in which a drachm of acetate of morphia was

[1] Dr. Roe, Am. Journ. of the Med. Sci., Feb. 1831.
[2] Annuaire, etc., 1845, p. 12.
[3] Ibid., 1847, p. 303.
[4] Am. Journ. of the Med. Sci., Jan. 1841.
[5] Ibid., July, 1847, p. 259.

swallowed intentionally. No amelioration of the symptoms occurred until large doses of coffee were administered, but from that period the patient began to recover.[1] We might here describe the remarkable power which belladonna and stramonium (or *mydriatics*, as they are called, from their power of dilating the pupil) display in enlarging the pupil contracted under the influence of opium and of neutralizing its narcotic operation, and reciprocally the virtues of opium in poisoning by the mydriatics. But these details will be found in the history of the articles which have just been named, and especially in that of belladonna.

Artificial respiration has occasionally been resorted to with success in poisoning by opium, but is undoubtedly inferior to other means. In infants the alternate compression and resiliency of the thorax may be used with advantage when the coma is profound. Enemata of turpentine and of assafœtida ought not to be neglected.

Among the external remedies for narcotism none is more efficient than *cold affusion*. Water at a low temperature should be dashed violently over the head and chest at intervals, and advantage taken of the momentary awakening thus produced, to attack the sensibility in a variety of ways. This partial restoration to consciousness is often attended with a renewal of gastric vitality, and emetics which had for some time remained quiescent in the stomach then begin to excite vomiting, and in this manner carry on still further the favorable influence of the cold affusion. Whatever vividly excites the attention helps to carry the system safely through the danger of narcotism, as we learn from instances in which strong mental emotion has actually suspended for a considerable time the symptoms of poisoning, and those still more numerous cases where pain artificially excited has averted the fatal lethargy. Flagellation with rods is one of the best methods employed. The patient should be supported between two stout assistants and forced to walk, while his bare back and loins are smartly fustigated by another person; nor should these means be laid aside until consciousness is completely restored. Ammonia or mustard may be applied to the epigastrium and extremities, and the former occasionally held to the nose. At intervals the patient may lie down and have his skin briskly rubbed with the hand; but for the most part he should be kept in motion, however earnestly he may beg to be let alone.

But it may happen that little or no impression is made upon the symptoms by emetics, the mydriatics, coffee, or external irritants, that the respiration is becoming rarer, the pulse weaker, and the stupor more profound. Even in such desperate circumstances a remedy remains which has been repeatedly used with success. This is electricity. It has generally been applied by means of an electromagnetic apparatus, with which shocks are transmitted along the spine and through the chest of the patient. Each shock of the proper strength arouses the sensibility, and induces a deep inspira-

[1] Annuaire, etc., 1845, p. 6.

tion which tends both directly and indirectly to overcome the asphyxia. Cases of the most unlooked-for recovery under the influence of this agent are recorded by Dr. Williams,[1] Dr. Page,[2] Dr. Taylor,[3] and many others, and show the importance of keeping an electro-magnetic apparatus at least in all public institutions, for in them the greater number of cases of narcotic poisoning are treated. The reaction which follows poisoning by opium or its preparations may possibly require local depletion from the head; but, during the symptoms of asphyxia, this measure is of very questionable utility, if, indeed, it is not positively mischievous. It has, however, been practised upon the ground that the soporose symptoms arise from cerebral congestion. This theoretical view is not sustained by the results of experience.

It may not be without profit to mention that the most successful means which have been employed to cure the habit of opium-eating consist in the gradual diminution of the dose of opium without the patient's privacy, and the equally gradual substitution for it of aromatic and stimulant tonics. Ginger, black pepper, colombo, and quassia may be employed successively for this purpose.[4] If this plan cannot be carried out, it is far better, for the sake of the patient, to insist upon an abrupt cessation of his habit than to attempt to win him from it by degrees. Indeed, so long as he allows himself to use the drug at all, he will pretty certainly yield to the temptation to use it immoderately. If he passes safely through the terrible trial of total abstinence, his cure may be counted upon as probable. But he must meanwhile be not only encouraged morally, but physically sustained. Dr. Alexander Fleming[5] prescribes 40 minims of dilute phosphoric acid, and 80 minims of tincture of lupulin (D.) an hour before meals in a wine-glassful of water. At bedtime there is given, to promote sleep, tincture of cannabis, 30 or 40 minims, and of Hoffmann's anodyne a fluidrachm, appropriately diluted. The food should at first consist of milk and beef-tea, for which, as the appetite improves, more solid aliment may be substituted. Alcoholic stimulants should, if possible, be avoided. Zinc, quinia, and iron, under various forms, must afford strength to the nervous system and a due body to the blood, and both must be improved by stimulating the skin by means of baths, friction, active exercise, and whatever will tend to withdraw the patient from those habits of solitude and self-contemplation in which his vice has immured him.

LACTUCARIUM.—LACTUCARIUM.

Description.—Lactucarium is the concrete juice of *Lactuca sativa*, or garden lettuce, a plant universally eaten with condiments,

[1] London Lancet, July 31, 1841.
[2] Am. Journ. of Med. Sci., April, 1843, p. 301.
[3] On Poisons in relation to Med. Juris., 2d Am. ed., p. 535.
[4] Mr. LITTLE, Month. Journ. of Med. Sci., June, 1850, p. 530.
[5] Brit. Med. Journ., Feb. 15, 1868.

as a salad, while it is young and tender. Even in this state its tendency to produce drowsiness is familiar to every one, although it then contains no appreciable quantity of the milky juice in which the hypnotic virtues of the plant reside. This should be procured by making incisions in the stem of the plant while it is in flower, and allowing the exuded juice to dry. An extract prepared by evaporating a decoction of the whole plant is nearly worthless. The smell of lactucarium is acrid and its taste bitter. It is generally found in reddish-brown masses, somewhat resembling opium. According to Buchner, the active principle is Lactucin, which is combined with resin. Lactuca virosa is said to yield three times as much lactucarium as Lactuca sativa. Aubergier describes the active principle as neutral, bitter, and crystallizable, insoluble in cold water, but soluble in alcohol.[1]

History.—The virtues of lettuce were well understood by the ancients. Celsus ranks it with the poppy as a soporific,[2] and it is mentioned more or less particularly by Galen, Dioscorides, and the writers of the Arabian school, who ascribe to it soporific and anaphrodisiac properties. Dioscorides even states that the juice of wild lettuce (*Lactuca virosa*) was regarded as so much like opium in its powers as to be employed for adulterating that drug. Both Paulus Ægineta and Galen refer to lettuce as a cure for watchfulness, and the latter, in particular, found it a sovereign remedy for that wakefulness which beset him in his old age, and when his mind was over-excited by study. The reputed powers of lettuce in allaying amorous desires procured for it the name of ἐννουχιον, or eunuch-maker; the same idea is conveyed by the custom of including this plant amongst the herbs used at the festival in commemoration of the death of Adonis; for Venus was fabled to have deposited the dead body of her favorite upon a bed of lettuce.[3] Ray[4] attributes to the strong-scented lettuce decided aphrodisiac virtues, but admits that the garden lettuce, before it has run to seed, is sedative and refrigerant. Rutty[5] points out that the hypnotic qualities of the plant reside in its milky juice, and says that it is useful in opacity of the cornea, and diseases of the skin, and prevents libidinous dreams. If modern observations have not directly confirmed the prevalent opinion of the ancient world upon the last point, they have at least rendered it probable, by showing the close analogy of the medicinal part of lettuce with opium, in everything but its stimulant qualities, upon which the aphrodisiac virtues of the latter entirely depend. Lettuce and its extract had nearly fallen into disuse, owing, probably to the more general employment of opium, particularly since the time of Paracelsus; and although the plant is mentioned by Bonetus and Sylvius as useful in uterine hemorrhage, and is briefly alluded to by Jones, Alston, Hill, and the other writers mentioned, no importance was

[1] Bull. de Thérap., xxiii. 64.
[2] Book ii. chap. xxxii.
[3] Anthon's Class. Dict., art Adonis.
[4] Synopsis Method. Stirp. Brittan., Lond. 1724, p. 162.
[5] Mat. Med. Nov. et Antiq., Rotterodami, 1775.

attached to it as a medicinal agent, by the profession in general, when Dr. John Redman Coxe, of this city, made experiments with its juice, which confirmed the opinions of the ancients in regard to it, and led to its being adopted anew into the materia medica.[1] Dr. Coxe gave it the name of *lettuce opium*. His opinions in regard to it were subsequently confirmed, in the main, by Duncan, of Edinburgh, Bidault de Villiers, François, Aubergier, and other continental observers.

Action.—Dr. Coxe reports lactucarium to possess stimulant qualities, causing acceleration of the pulse, and a general glow like that produced by a glass of wine. These effects, however, do not appear to have been noted in more than one or two cases, and may be explained by the medicine having been given in the form of tincture. Certain it is that such effects have not been observed to follow its administration in substance or in the form of a syrup. François,[2] who made use of the concreted juice of the plant obtained by incision, pronounced it to be destitute of any narcotic or intoxicating property such as belongs to opium, but admitted that it indirectly disposes to sleep by soothing pain, and diminishing the activity of the circulation. Fischer, who appears to have examined the subject carefully, arrived at a similar conclusion[3] to the above, and also to that of M. Bertrand, of Clermont,[4] who states that even in large doses it does not produce the headache, tinnitus, flushing of the face, and increased force and frequency of the pulse which so generally follow the use of opium in full doses. Martin-Solon,[5] who prescribed to several patients a syrup made by distilling an extract of the mature lettuce-stalks, found its effects similar to the preceding, and, in addition, noted that where this remedy failed of its purpose, opiates were equally ineffectual.

The general coincidence of the results obtained by the several experimenters who have been cited would appear to establish the possession of decidedly anodyne and sedative properties by lactucarium, but it must be admitted that some important counter-testimony exists which ought not, in fairness, to be concealed. This is furnished by Barbier and by Trousseau. The former refuses to lactucarium a place in the class of narcotic medicines, and classes it with extract of dandelion among the tonics. He affirms that in four or six grain doses it creates a sensation of warmth in the healthy stomach, and usually increases the appetite, but that in inflammatory states of the digestive canal, it augments the local suffering, and excites dryness of the fauces, and thirst. According to this author, it affects neither the circulation nor the respiration, but augments the flow of urine. In doses even of a scruple or half a drachm he alleges that it does not produce somnolence, or affect the intellect or senses, and he regards its supposed hypnotic and anodyne powers as altogether illusory. This inference, Barbier

[1] Trans. of Am. Phil. Soc., vol. iv. p. 387.
[2] Arch. Gén. (1825), viii. 258.
[3] Rust's Magazin, iii. 77.
[4] Annuaire de Thérap., 1843, p. 24.
[5] Bull. de Thérap., vol. ix. p. 320.

drew from a number of experiments made comparatively with lactucarium, mild preparations of opium, and doses of inert fluids prescribed under the name of the former medicine.[1] Trousseau, without denying to the drug all of the properties ascribed to it, states that he was unable to perceive any manifestation of them except from doses of from half a drachm to a drachm, while the original experimenters found them developed by doses no larger than those of opium.

Bouchardat concludes from his observations that the medicine is a very feeble soporific, but in doses of from four to six grains will procure a gentle sleep for very impressionable persons, at least for a short time, but that the susceptibility to its action is rapidly lost.[2] Marotte in like manner found that no appreciable effect was produced by less than four grains of lactucarium, and that this quantity had soon to be doubled, tripled, and even more.[3] To these statements it may be added that Bouchardat gave the preparation in half-ounce doses to dogs without any effect. Garrod, also, administered as much as sixty grains three or four times a day, without observing either a soporific or an anodyne effect;[4] while Fronmüller declared it to be soporific in doses of from ten to thirty grains.[5] It is not easy to reconcile these discrepancies in regard to matters of fact without supposing, what is indeed very probable, that the lactucarium employed by the different experimenters was obtained by different processes, was in some instances adulterated, and in others impaired by long keeping. Due allowance must also be made for the enthusiasm of the physicians who reintroduced the preparation into use. Any one who will read the articles which have been published concerning it must be struck by a fact common to them all: they dwell at length upon the circumstance that after its administration there is an absence of headache, nausea, constipation, itching of the skin, etc., which so commonly result from the use of opium. But it is evident that these statements are perfectly consistent with the want of all active properties in the medicine.

Lactucin, the active principle of lactucarium, is obtained in shining white rhomboidal scales, which have a strong and pure bitter taste, and are soluble in hot water and in alcohol, but not in ether. According to Fronmüller, in doses varying from one to ten grains it produces more or less sleep, and in the latter dose is apt to occasion eructations, giddiness, dreams, and itching of the skin. It hence appears probable, that, however feeble a hypnotic lactucarium may be, lactucin is feebler still.[6]

Uses.—The *medicinal virtues* of lactucarium will readily be inferred from the preceding remarks. It is appropriate for combating nervous restlessness in all diseases affecting very impressionable persons, for relieving the watchfulness which so generally follows

[1] Op. cit., vol. iii. p. 302.
[2] Annuaire de Thérap., 1857, p. 12.
[3] Bull. de Thérap., li. 512.
[4] Times and Gaz., March, 1864, p. 334.
[5] Ibid., p. 348.
[6] Husemann, Die Pflanzenstoffe, p. 943.

mental excitement, for allaying pain of a moderate degree, and as a substitute for opium in all cases where the milder effects of this medicine are desirable, and any peculiarities of the patient are opposed to its exhibition. Thus, it is preferable to other narcotics for infants. Dr. Duncan first recommended it as a valuable palliative of the cough in phthisis,[1] and, *if* it answers the purpose intended, it is preferable to opium, which is so apt to diminish the appetite and enfeeble the digestion, and thus diminish the power of the patient to resist the wasting influence of the disease.

It is difficult to determine in what *dose* lactucarium should be administered, since authors of equal repute direct it, some in doses of one or two grains, and others in ten-grain doses, to be frequently repeated, and rapidly increased to half a drachm or more. The most judicious plan is, doubtless, to begin with the smallest quantity mentioned, and augment the dose daily, or administer it at shorter intervals, until a decidedly anodyne or hypnotic effect is produced. This caution is, indeed, only necessary to prevent the administration of doses so large as to disagree with the stomach, for there is no case on record of poisoning, or an approach thereto, by any amount of lactucarium that has hitherto been prescribed.

HYOSCYAMI FOLIA.—Hyoscyamus Leaves.

HYOSCYAMI SEMEN.—Hyoscyamus Seed.

Description.—The officinal name of this medicine is derived from two Greek words, ὑς, a hog, and κυαμος, a bean, indicating that it is a kind of food of which hogs are fond. The vulgar appellation (*henbane*) refers to its poisonous effect upon fowls. *Hyoscyamus niger* is an annual or biennial (*Houlton*) plant of the natural family *Solanaceæ*, and is a native of Europe, but naturalized in the United States. When mature, it is from two to four feet in height; the leaves are large, long, deeply incised, like the stem hairy, and of a pale-green color; at the upper part of the stem they are sessile, soft, cottony, and clammy, and exhale a rank, heavy, and sickening odor, which has been compared to that of the black currant. The flowers, which are gathered at the top of the stem in depending spikes, are sessile, and have a funnel-shaped corolla of a pale-yellow color on the edges, and variegated with dark-purple veins. They are succeeded by capsules containing numerous small kidney-shaped black seeds, reticulated on the surface.

The root is a long, somewhat branching, tap-root, rough and brown without, but white within. Its juice, like that of other parts of the plant, exhales a rank smell, and possesses powerful narcotic properties. From its resemblance to certain edible tap-roots, and

[1] Observations on the Distinguishing Symptoms, etc., of Pulmonary Consumption, 2d ed. (Edinb., 1816), p. 174. The name *Lactucarium* was imposed by Dr. Duncan.

particularly that of the parsnip, it has frequently been eaten by mistake, and produced poisonous effects.

The active principle of hyoscyamus, *Hyoscyamia*, is described by Schroff as an amorphous, semitransparent, viscid mass, of a sharp, biting, nauseous, and bitter taste. Geiger obtained it in transparent, stellate, and silky crystals, and Harley describes the sulphate deposited from a solution as "a radiated mass of soft prisms," having a "heavy tobacco-like odor and a bitter tobacco-like taste." It is soluble in water, alcohol, chloroform, and ether.

EXTRACTUM HYOSCYAMI.—*Extract of Hyoscyamus.*

This extract is prepared by evaporating the expressed juice of hyoscyamus leaves to a proper consistence.

EXTRACTUM HYOSCYAMI ALCOHOLICUM.—*Alcoholic Extract of Hyoscyamus.*

This preparation is made by the percolation of diluted alcohol through powdered leaves of henbane, and the evaporation of the product.

Both of these extracts are of very uncertain strength, and often quite inert. The latter is, however, most apt to be of good quality. Their average dose is two or three grains; and in all cases it is advisable to increase the dose rapidly, but by degrees, until some characteristic narcotic phenomena are developed.

EXTRACTUM HYOSCYAMI FLUIDUM.—*Fluid Extract of Hyoscyamus.*

It is prepared by exhausting sixteen troyounces of the leaves with alcohol, water, and glycerine, so as to produce a pint of the fluid extract. Dose, five minims.

TINCTURA HYOSCYAMI.—*Tincture of Hyoscyamus.*

The tincture is prepared by percolation, with four troyounces of powdered henbane leaves in diluted alcohol so as to produce two pints of tincture. It is laxative and narcotic, and may be given in the dose of a fluidrachm.

Medical History.—Hyoscyamus has been recognized as a medicinal agent from the earliest periods of medical history. Many of the ancient writers, indeed, draw distinctions between the several varieties of the plant from which the extract was procured, condemning two of them as unfit for medicinal purposes on account of their virulent qualities. One of these, the black, is that most generally employed at present, while in France this variety, and also the white, which the ancients alone admitted into medicine, are used as possessing identical properties. Although this agent was never, as some writers state, entirely disused, it nevertheless fell into comparative neglect during the eighteenth century, until it was introduced anew to the confidence of physicians by the publication of Störck in 1762, since which time it has continued to hold a rank among narcotic medicines.

Action. *On Animals.*—As its name implies, hyoscyamus may be eaten by swine with impunity; it is also said to be innocuous to cows and sheep, while deer, barnyard fowls, and fish are poisoned

by it. According to Orfila's experiments, it acts upon dogs as upon the human species. Hyoscyamia is poisonous to rabbits, although twenty times the quantity of a strong alcoholic extract does not injure them. According to Schroff $\frac{1}{4000}$ grain will in fifteen minutes produce a dilatation of the pupil which reaches its maximum in forty minutes, maintains it fully for one or two hours, and then gradually declines during the succeeding five or six hours. Dr. Harley's experiments show that it renders the cat dull and lethargic, dilating the pupils, drying the mouth, and accelerating the pulse; the animal walks feebly and clumsily and as if benumbed. In the dog precisely the same symptoms are observable, and they are identical with those produced by belladonna. The mouse exhibits like effects, but the soporific phenomena are more evident. Dr. Harley is of opinion that hyoscyamus is wholly eliminated by the kidneys. Its diuretic action is marked, and the urine possesses the power of dilating the pupil. In small doses it is a sedative and a tonic to the heart, but in excessive doses it depresses and debilitates this organ. On the brain its action resembles that of opium, without exciting the motor function as opium does. On the reflex function its action is to exaggerate it, causing muscular twitchings, etc., as is plainly shown when a frog is placed under its influence. On the respiratory function its action is like that on the heart, to which, indeed, it is closely related; that is to say, it renders the breathing calm during the sleep caused by the drug.

On Man.—Whether the preparation of henbane be introduced into the stomach or bowels, or applied to the denuded cutis, its action is the same. M. Ratier[1] and Mr. Judd[2] have described the effects upon themselves of full doses of this medicine. The former took, fasting, ten grains of a carefully prepared alcoholic extract. After the lapse of an hour he experienced headache, which became rapidly more severe, pastiness of the mouth, and a savor which he compared to that of a mixture of sweet and bitter, and which masked completely the taste of sapid bodies. The tongue was covered with white fur, and the throat was hot and dry, the skin warm and halituous, and the pulse slightly accelerated. A short slumber followed, on awaking from which M. Ratier found his pupils so dilated as scarcely to leave a trace of the iris visible; he saw imperfectly, walked with a tottering gait, and experienced a numbness of the lower limbs. In four hours these symptoms had disappeared, except the dryness and bad taste in the mouth, which continued until the following day. In Mr. Judd's case the attention was chiefly attracted by a fluttering movement of the heart, and a corresponding rapidity and smallness of the pulse. The sense of touch was also very much impaired, the voluntary muscles were affected with spasmodic jerkings, or were cramped, while the bladder could not be evacuated except by repeated efforts.

The experiments of Schroff, the results of which will now be given, appear to settle very conclusively the operation of hyoscya-

[1] Arch. Générales de Méd., i. 307. [2] Lancet, i. 776.

mus, and its peculiarities as compared with other medicines of the narcotic class. Small and medium doses (1 to 4 grs. of the ethereal extract) occasioned a fall of twenty or thirty strokes in the pulse within the first two or three hours, and the more rapidly the larger the dose. But, on the other hand, the larger the dose the more speedily reaction occurred, and the pulse resumed its original rate, or became still more frequent. Even small doses occasioned disturbance of the head, dryness of the mouth and fauces, and a sense of weariness; larger quantities produced dulness and sleepiness; still larger ones, a sort of coma vigil, or a heavy deep sleep, disturbed by frightful dreams; sometimes decided headache, dizziness, deafness or buzzing in the ears, feebleness of vision, making it impossible to distinguish printed letters; a morbid sensitiveness of the eye to light; an impaired sense of smell, while that of taste remained unaltered; and an inability to fix the attention, which sometimes continued for two days. The muscular debility and swimming in the head made walking difficult, and the dryness of the throat rendered swallowing almost impossible, while the voice became hoarse or harsh, and the skin dry and cool. On the day following the experiments there was diarrhœa, and nausea with straining, and a discharge of bloody mucus from the nose.

At the risk of some repetition a summary may here be presented of Dr. Harley's experiments with hyoscyamia.[1] Even the dose of $\frac{1}{40}$ grain of sulphate will cause the pulse rate to fall from 80 to 50 or 60. Doses of $\frac{1}{12}$ to $\frac{1}{10}$ grain will primarily accelerate the pulse by six or twenty beats and for the period of about an hour, after which it slowly declines, but gains in force and volume. When the dose of $\frac{1}{30}$ to $\frac{1}{24}$ grain is injected hypodermically, in the course of from ten to twenty minutes the tongue grows more or less completely dry, rough, and brown, and the hard and soft palates dry and glazed; there is excessive giddiness with a weight across the forehead, somnolency, occasionally a little flushing of the cheeks, and injection of the membranes of the eye. After an hour these symptoms pass off; and the tongue and hard and soft palates become covered with a sticky, acid, offensive secretion. The pupils slowly dilate during the latter part of the action of the medicine, and at its close attain their maximum degree of dilatation. If larger doses than $\frac{1}{12}$ of a grain be given, these effects will increase and be prolonged for two or three hours, being accompanied either with wakeful quiet and usually pleasing delirium with illusions of the sight; or with such excessive somnolency, that the patient cannot keep the eyelids raised for a few seconds, but when aroused, lapses again into a dreamy sleep, broken by occasional mutterings and slight jerkings of the limbs. In either case, the power of maintaining the erect posture will be lost, and at best the patient reels like a drunken man.

These phenomena closely resemble such as are produced by belladonna, yet they differ sensibly in the absence of any action upon

[1] Old Vegetable Neurotics, p. 322.

the sphincter ani muscle and of that peculiar propensity to laugh and dance which the latter agent occasions. They differ strikingly from those of opium in respect of the relaxing influence on the bowels and the relatively feeble narcotic powers of hyoscyamus. The comparative action of hyoscyamia, atropia, and daturia is of particular interest. They all dilate the pupil, and produce dryness of the mouth, throat, and air passages; occasion fulness of the head, giddiness, hallucinations, and delirium; in small doses reduce the frequency and force of the pulse, and in large ones speedily restore it to its original rate or carry it still higher. But their degrees of action are different, hyoscyamia being the most powerful when applied locally to dilate the pupil, but in all other respects feebler than the other two agents. They differ, also, as to the nature of their action in several particulars. Daturia and atropia almost always, in large doses, occasion a scarlatinoid eruption on the skin; but hyoscyamia exceptionally only. Atropia and daturia, in large doses, always excite an ecstatic or even maniacal delirium, with a strong propensity to rapid motion and every sort of extravagant act, in spite of a real debility and tendency to fall, but hyoscyamia only does so exceptionally, and when the dose of it is very excessive. If the accounts given below can be relied on, it tends to excite pugnacity rather than hilarity. Daturia and atropia cause relaxation of the sphincters of the bladder and rectum, and also of the iris; but hyoscyamia affects the former muscles less, and the latter more, than they. The two first-named alkaloids, which are identical in their action, as they are also in their chemical relations, are therefore different from hyoscyamia, since its physical as well as its physiological qualities are unlike theirs.

In very large doses, hyoscyamus occasions such distinct and remarkable symptoms as to have been described by medical writers in every age. Hippocrates, in his treatise on the diseases of women, and Dioscorides, state that it is capable of exciting delirium, which the last-named writer very aptly compares to the delirium of drunkenness. Scribonius Largus calls the medicine *altercum*, because, as he remarks, it gives rise to garrulous delirium, with altercation.[1] Wepfer[2] relates an extraordinary account of the effects produced by the roots of hyoscyamus niger on the inhabitants of a monastery, who had eaten them for supper by mistake. Soon after retiring many of the monks were seized with vertigo, dryness and heat of the fauces, contortions of the trunk, and disorder of the limbs. At matins one imagined that he had to read the service for the dying; another fancied he was cracking nuts, and pretended to throw the empty shells away. Among those who reached the chapel some could not read, others read what was not in the book, and to others the letters appeared to be running about the page. In another case, recorded in the *Ephemerides Cur. Nat.*, two female servants, who had to prepare and apply repeatedly a fomentation of henbane leaves to their mistress, were seized with delirium and

[1] See also HOFFMANN, i. 200, 223. [2] Cicut. Aquat. Hist. et Noxæ.

vomiting; they quarrelled, and at last came to blows. Still another instance of the sort is contained in the same work. Two apothecary's apprentices, who were drying henbane seeds upon a stove which grew too hot, became intoxicated by the poisonous fumes, made extravagant gestures, and at length fell to fighting. One of them subsequently was attacked with vomiting and purging; he laughed, danced, and sang;[1] and for some weeks afterwards complained of depression of spirits, debility, giddiness, and headache.

Such maniacal excitement is not, however, of ordinary occurrence after an overdose of hyoscyamus. A case is recorded at length by Dr. Harley of a very quiet and amiable gentleman who, under the influence of eight grains of ordinary extract of henbane, became unnaturally and persistently loquacious in regard to imaginary events which appeared to pass in a panoramic picture before him: "It was necessary," says Dr. H., "in order to avoid any increase of excitement, to treat him with silence." More commonly there are fulness and heat of the head, flushing of the face, injection of the eyes, and cerebral excitement manifested by indistinct or clouded vision, and sometimes total blindness, giddiness, delirium, and hallucinations. Sometimes natural objects assume a grotesque appearance, or the field of vision is filled with luminous figures. There is little or no inclination to sound sleep, but a sort of somnolence with incoherent mutterings, like that which is so common in typhus fever. Sometimes the hearing is lost. The pupils are usually, but not always, dilated, the muscles of the throat and chest, and of the lower limbs, may be affected with tetanic rigidity, or clonic spasms, and there is a more or less complete loss of power in the same parts, which is apt to continue after the attack. Aphonia is by no means uncommon. General sensibility is, in most cases, very much impaired, while at the same time there may be severe neuralgic pains in the course of the principal nervous trunks. The skin may be cool and clammy, and is apt to be bathed in perspiration, which is sometimes cold, when a large dose of the drug has been taken; the face is also pale, and the lips purplish, but smaller quantities, exhibited for several days in succession, more frequently render the skin dry and itching, or produce a papular eruption upon its surface. Sometimes the tongue is paralyzed and the pharynx spasmodically contracted. Dr. Craik, of Montreal, describes the eruption in a case observed by him, as "a bright scarlet redness of the whole surface, exactly resembling that of scarlatina."[2] Vomiting and diarrhœa, with colicky pains, are of usual occurrence. Death may ensue upon the graver symptoms which have been enumerated, but, considering their formidable appearance, this termination is comparatively rare.

The dose which may be considered as poisonous is very uncertain. As Orfila long ago pointed out, the extract of hyoscyamus some-

[1] A case in which these symptoms occurred is reported by SHILLIZI, Arch. Gén., Mai, 1854, p. 604.

[2] RANKING'S Abst. (Am. ed.), No. 28, p. 134.

times appears to be perfectly inert. Mr. Donovan took an ounce of the tincture of the leaves, and M. Hirtz administered from seven to twelve grains of the extract, with little or no perceptible effect; hence Mr. D. expressed the opinion that the tincture of the leaves of hyoscyamus should be expunged from the Pharmacopœia. His suggestion has not, however, been acted upon in Great Britain, or in this country. On the other hand, very small doses of the extract occasionally produce symptoms of poisoning. Thus, in a case related by Dr. Keating, they were produced by a single dose of three grains, and that in a woman who, within the previous fortnight, had taken very large quantities of opium. In another, mentioned by Dr. Ruschenberger, four grains occasioned them.[1]

Administered by the rectum, hyoscyamus may give rise to symptoms of poisoning. A female affected with organic uterine disease injected into the rectum a decoction of the plant. Instantaneously she was attacked with giddiness and confusion of sight, she talked at random, and presently fell, exhausted. Remedies were at once employed, but the effects of the poison were manifested for several months in great disorder of the nervous system.[2]

A very singular peculiarity of this medicine is stated by Dr. Harley to be that children will usually bear very large doses of it. Thus a fluidounce of the tincture of the *juice* given to children under twelve years of age produced no other effects than an acceleration of the pulse attributable to the alcohol, and towards the close of the action a moderate dilatation of the pupils. The mouth usually remained clean and moist, and often there was no trace of giddiness or stupidity. In young adults and some children such doses usually produce a grateful soporific effect. Old persons are very readily influenced by the medicine, and generally delirium is the chief symptom. "Four grains of the extract or half a drachm of the tincture will sometimes produce this effect."

Remedial Employment.—The ancients made use of hyoscyamus internally to palliate cough, and with a view of controlling hemorrhages particularly from the uterus, but they employed it much more extensively as a topical anodyne in earache, toothache, gout, and glandular inflammations.[3] Beyond this, and its recommendation for epilepsy and dysentery, scarcely any extension was given to its employment until the time of Störck, who vaunted its virtues in convulsions, internal spasms, palpitation of the heart, mania, and melancholy, difficulty of expectoration, hæmoptysis, epilepsy, and chronic headache.[4] As happens in the case of all new remedies, the vogue of hyoscyamus was at first unbounded, and the assertions of Störck met with ready confirmation in all countries. But, as occurs in other cases too, more cautious and prolonged observation detracted not a little from the fame of the newly-discovered panacea. Its activity no one could deny, nor doubt the

[1] Am. Journ. of Med. Sci., July, 1858, p. 96. [2] Abeille Méd., x. 316.
[3] Adams, Comment. on Paul. Æginet., vol. iii. p. 383.
[4] Ratier, art. cit.

reality of the symptoms which large doses of the drug produced; but to admit that it was a poison, on the one hand, and, on the other, to concede its therapeutical powers, are two independent propositions, each of which must stand upon its own proofs, and the latter has been strongly, and upon apparently good grounds, contested. Greding determined by numerous experiments that if in some instances the main disease was palliated, and in others certain troublesome symptoms disappeared, these advantages were insignificant when compared with the mischances attributable to the medicine.

Ratier, who has given the results of the experiments instituted by Professor Fouquier upon patients affected with epilepsy, hysteria, hypochondriasis, neuralgia, lead-colic, acute articular rheumatism, and cancer of the uterus or bowels, came to the following, among other conclusions: 1st. That henbane is not as powerful a remedy as had before been supposed; 2d. That many cures are attributed to it which the smallness of the dose prescribed renders incredible; 3d. That positive indications for its use are still wanting; 4th. That it is improper in cerebral affections; 5th. That it possesses no uniform or direct control over nervous disorders; and 6th. That it is not a soporific. With the last statement Dr. Chapman's experience agrees. He found, however, that it sometimes disposes to rest by easing pain or soothing irritation.[1] The foregoing results of experiments carefully conducted by competent observers, ought to be borne in mind in estimating the opinions of authors upon the efficacy of henbane in particular diseases. At the same time, it is evident that one of them at least is erroneous. Beyond all question hyoscyamus is soporific; but to display such a power it must be given in appropriate doses.

Neuroses.—Mayerne, Störck, Gilibert, and others affirm that hyoscyamus is a valuable means of curing *epilepsy*, but, besides the fact that no less has been alleged of a multitude of other agents, we have the counter evidence of Scardona and Tissot, that the remedy is always dangerous, and that if it temporarily suspends the attacks, they afterwards return more violently: Greding, moreover, testifies that among fourteen epileptics treated by it, the luckiest were they to whom it did no mischief.[2] In epilepsy arising from emotional disturbances, and in this form only, Dr. Harley found it very serviceable, in doses of half an ounce to an ounce and a half of the juice or of the tincture given occasionally. In *mania*, for which it was recommended on the principle of substitution, no recent writer of authority commends it. There is more show of its utility in the opposite state of mental disorder, or *hypochondriasis*, for which Frank regards it as a valuable remedy, and Dr. Sigmond thinks that in this disease it is particularly adapted not only to procure sleep, but to soothe the disordered spirits with more quickness and certainty than anything else. Whyte mentions it as a succedaneum to opium, although inferior, and directs from a grain and a half to

[1] Op. cit., art. Hyoscyamus. [2] Tissot, Œuvres, vol. x. p. 338.

three or four grains of the extract, night and morning, for the purpose of quieting nervous and hysteric symptoms, when opium confines the bowels.[1] Dr. Harley regards its power as a general sedative of the *heart* as its most eminent virtue. In functional disturbance arising from emotion, the subcutaneous injection of one $\frac{1}{48}$ of a grain of sulphate of hyoscyamia "exercises a most speedy and beneficial influence." According to the same authority it is the appropriate remedy in *cardiac and pulmonary asthma*, and will often bring immediate relief.

Neuralgia and other Painful Affections.—In facial neuralgia, pills consisting of one grain of extract of henbane, and one of oxide of zinc, were greatly extolled by Meglin. Their dose was increased daily, until the sight became affected, or they disagreed with the stomach. An attempt has been made to show that the alleged activity of the medicine resided in its vegetable ingredient, but the very insignificant success which has attended its administration by other hands than the inventor's diminishes the interest of this question. This may have been owing to the feebleness of the preparation and the smallness of the dose. The anodyne power of large doses of hyoscyamus are undeniable. A poultice of the fresh leaves of henbane is useful in calming neuralgic as well as other pains, but has no superiority over that made with stramonium leaves, and is not, perhaps, equal to other forms of narcotic fomentation. All severe local pains of the paroxysmal sort are much more amenable to opium given internally, conjointly with analogous applications to the affected part; but where an anodyne must be taken habitually, and there is any peculiar morbid susceptibility to the effects of opium, hyoscyamus may be advantageously substituted. Under these circumstances, and provided no febrile excitement or headache be present, it frequently merits the encomium of Dr. Christison, who states that it allays pain, soothes excitability, and induces soft refreshing sleep. The anodyne properties of henbane may also be employed for correcting the tendency to gripe, which belongs to the resinous and some other purgatives. For occasional catharsis, the association of the principal medicine with laudanum is preferable, but hyoscyamus enters more appropriately into the composition of those pills and other forms of laxative medicines which are intended to be used habitually. By the Germans, it is employed almost to the exclusion of opium, in the diseases of children.

Hemorrhages, etc.—There are three conditions in which hyoscyamus has been recommended as a medicine of great utility; these are local inflammation, hemorrhage, and glandular swelling or degeneration. It cannot be pretended that it possesses any specific influence over the first two disorders, nor any, indeed, which is not referable to its anodyne properties, and these, it is believed, are also quite sufficient to account for its alleged resolvent power. For nothing is better established than that the tendency of pain in a

[1] Obs., etc., On Nervous Disorders, p. 363.

part is to hasten and aggravate the morbid processes of which it is the seat. However this may be, opium is incomparably superior to henbane in the affections referred to. The property which hyoscyamus has of dilating the pupil is employed for the purpose of exploring the interior of the eye, breaking up adhesions in iritis, and facilitating operations for cataract. In this respect, according to Schroff, it is superior to stramonium and belladonna, acting more quickly and intensely, and maintaining the dilatation for a longer time. Its solubility in water also renders it preferable to the other mydriatics. A solution that will keep without decomposition, and is strong enough for the purpose in question, may be made with one part of hyoscyamia to one thousand of distilled water and ten of alcohol.

The treatment of poisoning by hyoscyamus is nearly the same as that recommended for poisoning by belladonna and stramonium. Emetics, the stomach pump, warmth to the extremities, cold to the head, and if stupor supervenes, internal and external stimulants may all be directed. When the poison has all been evacuated, acid drinks are recommended to be given, and opium first as a direct antidote, and afterwards to quiet the nervous agitation which remains.

If, now, it were required to express in a summary manner the therapeutic value of hyoscyamus, as deduced from the considerations which have been presented, the statement need be very brief. In every case to which opium and hyoscyamus are equally applicable, the former is infinitely to be preferred; where opium under no form and in no combination can be tolerated, its anodyne effects may be imperfectly produced by hyoscyamus; as a corrective to the irritant properties of several cathartics, when it is necessary to administer them repeatedly, hyoscyamus is preferable to opium, as having no tendency to confine the bowels; as a means of dilating the pupil, hyoscyamus is superior to all other agents. This is, indeed, a brief catalogue of virtues compared with what have been often ascribed to hyoscyamus, but a close scrutiny of the evidence in its favor will, we believe, admit no more.

Administration and Dose.—Hyoscyamus is administered in substance, extract, juice, and tincture. The first is not a usual mode in this country, but if preferred, from five to ten grains of the powdered leaves or seeds may be given. Of the officinal extract, the minimum dose is about two grains, and of the juice or tincture, one or two fluidrachms. But, as Alston long ago said, "the dose of henbane is uncertain," more uncertain than that of any other narcotic. In every case, therefore, where it is proposed to employ it frequently, a small quantity should be prescribed at short intervals, and continued until a decided impression is made. By this experiment alone is it possible to graduate the dose according to the patient's susceptibility or to the strength of the preparation employed.

Hyoscyamia is recommended by Schroff as a mydriatic in a solution of one part to a thousand of water with the addition of ten

parts of alcohol. It may be given internally, according to the same authority, in doses of $\frac{1}{20}$ to $\frac{1}{15}$ grain.

BELLADONNÆ FOLIA.—Belladonna Leaves.

BELLADONNÆ RADIX.—Belladonna Root.

Description.—Atropa Belladonna, also called Solanum maniacum, S. somniferum, and S. lethale, is a plant of the natural family of Solanaceæ. Its native country is Southern Europe, but it flourishes, when cultivated, in the United States. It generally grows in shaded places, along ditches, hedges, and ruined walls. The plant, which is much admired for its beauty, has a perennial herbaceous stem of a purplish color, cylindrical, branched, somewhat tomentose, and three or four feet in height. The upper leaves are in pairs, the lower alternate, oval, pointed at both ends, soft, of a dark-green color above, but lighter beneath. The flowers are axillary, pedunculated, and form cylindrical purple bells. They are succeeded by a berry which is at first green, then red, and, when ripe, of a dark-purple color, and closely resembles a cherry in appearance. It contains in two separate cells a number of kidney-shaped seeds, and its juice has a sickly sweetish taste. The root is fleshy and creeping. All parts of the plant exhale a nauseous and rank odor, and are pervaded by its narcotic principle.

The active properties of belladonna depend upon *atropia*, an alkaloid principle, which was discovered by Brandes, and stated by him to exist in the form of a malate. It is very soluble in alcohol, somewhat less so in ether, and it requires three hundred parts of water at 60° for solution.

Extractum Belladonnæ.—*Extract of Belladonna.*

This preparation is the inspissated expressed juice of the leaves. Its average dose for an adult is one-quarter of a grain, and for infants, not more than one-twentieth of a grain should be administered at first.

Extractum Belladonnæ Alcoholicum.—*Alcoholic Extract of Belladonna.*

It is prepared by percolation and evaporation. Its dose is the same as that of the simple extract.

Extracum Belladonnæ Radicis Fluidum.—*Fluid Extract of Belladonna Root.*

A pint of this preparation contains the virtues of sixteen ounces of belladonna root; two minims of the former representing one grain of the latter.

Tinctura Belladonnæ.—*Tincture of Belladonna.*

This tincture is prepared by percolation, and, when made from recently dried leaves, is an active preparation. One pint of it contains the virtues of two troyounces of the leaves. It is less used

than the extract, but may be given in doses of fifteen or twenty drops.

ATROPIA.—*Atropia.*

A sulphate of atropia is formed by the action of diluted sulphuric acid upon powdered belladonna root, and the alkaloid is precipitated by the addition of solution of potassa. It forms "yellowish-white, silky, prismatic crystals, without smell, but having a bitter and acrid taste."

ATROPIÆ SULPHAS.—*Sulphate of Atropia.*

This preparation is made by saturating an ethereal solution of atropia with sulphuric acid, and evaporating to dryness. It is a white, slightly crystalline powder. This is too potent a medicine for general administration. With due caution, however, it may be given in the dose of from one-fiftieth to one-twentieth of a grain. From one-thirtieth to one-twentieth of a grain may be applied endermically; for hypodermic use a solution of one grain of sulphate of atropia in a fluidounce of water is convenient. Of this from five to eight minims ($=\frac{1}{100}$ to $\frac{1}{60}$ gr.) is a medium dose.

History.—Belladonna was so called by the Venetians, because, according to some writers, it entered into the composition of a cosmetic employed by the Italian ladies. Others will have it that the visions of beautiful women which it sometimes excites, conferred its name upon the plant. Its popular name (Deadly Nightshade), which is of German origin, is probably derived from the poisonous qualities with which every part of the plant is endowed.

Most commentators agree that Στρυχνος μανικος of Theophrastus was belladonna, but no authentic notice of belladonna, under that name, occurs in medical literature before the sixteenth century. For one hundred and fifty years longer it is chiefly referred to by writers as a poison, under the name of *solanum furiosum*, a title derived from the peculiar delirium which it excites when given in excessive doses. In the latter half of the seventeenth century it began to be recommended as a resolvent and anodyne in cases of cancer, by many German and several English physicians,[1] and towards the close of the eighteenth century it came into general use as a remedy for spasmodic and other nervous disorders.

Action. *On Animals.*—Mr. Anderson, according to Pereira, states that blackbirds eat the berries of belladonna with impunity; but M. Flourens found that birds fed by him with this substance became blind. On examining them after death, he observed that the cranium was stained red opposite the corpora quadrigemina, from which, and from its effect upon the sight, he concluded that these nervous ganglia were chiefly acted upon by the poison.[2] Herbivorous animals do not appear to be affected by devouring any part of the plant, if we may judge by experiments performed upon the horse, the ass, and the rabbit. The active principle of the plant was discovered in the urine of the rabbit, showing that the

[1] SPRENGEL, Hist., etc., vol. v. p. 478. [2] Recherches, etc., 1824.

animal had escaped danger by eliminating, and not by assimilating, the poison. Bouchardat fed two rabbits for a month exclusively on belladonna leaves, without any harm to them. A similar experiment had previously been performed by Runge, with a like result, and the urine of the rabbit applied to a cat's eye was found to dilate the pupil. Reisinger also found rabbits insensible to the poison. More recently, Dr. W. Ogle repeated and varied these experiments, and found not only that rabbits can eat belladonna leaves without inconvenience, but can take by the stomach without injury, a dose of atropia that would kill a man. It having been objected that the stomach destroyed the peculiar qualities of the poison, atropia was administered hypodermically to rabbits, with the result that no poisonous effect was produced even by a dose of five grains. At the same time, the application to the eye of atropia occasions dilatation of the pupil in these animals.[1] These careful, varied, and decisive experiments supersede the rather crude observations of Lemattre,[2] who attributes the apparent immunity of rabbits from the poisonous action of belladonna "to the slowness of absorption from their stomach." The berries of belladonna administered by Orfila to dogs produced no result, but these animals were readily poisoned by the extract taken into the stomach, or injected into the veins, and exhibited, along with dilated pupils, the symptoms already described as belonging to narcotic poisoning in quadrupeds. According to Reisinger, experiments with atropia have produced similar results, when it was given in doses even of a single grain.[3] Dr. Percy[4] gave a quarter of a grain of sulphate of atropia to each of several dogs, and observed that when the animals were allowed to drink water, they recovered more rapidly and completely than when water was withheld. In the latter case when the animals died their kidneys were highly congested. Bouchardat on one occasion introduced a grain, and on another, three grains of atropia into the cellular tissue of a rabbit's limb, but no poisoning resulted. But when dogs were subjected to similar experiments, they became agitated, and were unable to stand up, or to walk without stumbling. When two grains of atropia were injected into the crural vein of a dog, the animal uttered a shrill howl, and fell stiff and apparently dead upon the ground, but recovered in five or six minutes sufficiently to walk across the room. After some hours of rest, the symptoms disappeared.[5] The experiments of v. Bezold and Bloebaum[6] led them to the following among other conclusions: The action of atropia, in small doses, on the heart, begins with a paralysis of the nervous extremities in that organ, whereby its pulsations are rendered more rapid, and indeed, as rapid as possible. Larger doses lessen the incitability of the organic nervous centres as well as the ends of the nerves, causing dilatation of the capillaries, reducing the fre-

[1] Times and Gaz., May, 1867, p. 466.
[2] Arch. Gén., Juill. 1865, p. 43.
[3] Arch. Gén., t. xviii. p. 300.
[4] New York Med. Journ., viii. 250.
[5] Annuaire de Thérap., 1849, p. 14.
[6] Untersuch. aus d. Phys. Laborat. in Wurzburg., i. 55.

quency of the heart's pulse, and lessening the irritability of the cardiac muscles. The largest dose of the poison thrown into the circulation and the heart depresses the force of its impulse and lessens the intensity of its sounds; the one grows weaker and weaker, and the latter fainter, until the organ ceases to beat. These results are intrepreted by the author as demonstrating the power of atropia to diminish or destroy the power of the par vagum to regulate the movements of the heart.

In Dr. Harley's experiments with atropia on the horse. hypodermic injections containing from one-twelfth of a grain to two grains were employed. The general results, as interpreted by him, were: 1. Powerful stimulation of the heart, shown by a greatly accelerated pulse, with diminished force of the heart's action and tone of the bloodvessels. 2. A general quieting effect on the cerebro-spinal system is produced by moderate doses; but after large doses an increased sensibility to external impressions, for the hearing becomes excessively acute, and although visual impressions are indefinite, they are acutely perceived. Wakefulness and slight restlessness result from the prolonged action of large doses, and the eyes are injected. 3. Diuresis is usual, and the biliary and intestinal secretions are slightly increased. 4. The respiration is unaffected. Atropia was administered in a similar manner to dogs, the doses ranging from one-ninety-sixth of a grain to one-fourth of a grain. In the dog the influence on the heart is more strongly marked than in the horse, while the cerebral effects are much less decided.

On Man.—In very small doses, the only effect of belladonna is to produce dilatation of the pupils. In somewhat larger quantities, particularly if administered for several days in succession, it occasions dryness of the fauces, and in some instances gives rise to a reddish efflorescence on the skin. These symptoms may all appear without the slightest disturbance of the cerebral functions.

The effects of larger doses of belladonna can best be learned from an analysis of the symptoms which have been observed in poisoning by this substance. Examples of this accident are very numerous, and have generally arisen from eating the berries of the nightshade, which are not unlike cherries, and have a rather pleasant, although mawkish taste. In the case of a boy, nearly three years old, who swallowed five grains of extract of belladonna, there was delirium followed by sleep and a pulse of 180.[1] Another boy, æt. 4, who took six grains of the extract, presented the very same symptoms.[2] Both recovered. In a third case three-sixteenths of a grain of sulphate of atropia were taken by a girl of six years; the characteristic phenomena were all present.[3]

The symptoms produced by *medicinal* doses of belladonna or atropia are set forth in detail below as they are manifested by the several physiological elements of the economy; but it may not be

[1] Guy's Hosp. Rep., 3d ser., xiv. 267.

[2] Boston Med. and Surg. Journ., June, 1872, p. 385.

[3] Guy's Hosp. Rep., 3d ser., xvii. 226. For other cases, vid. Boston Med. and Surg. Journ., July, 1870, p. 41; and Virchow's Archiv, xlviii. 188; xlix. 451.

superfluous in this place to present them in a brief summary. The hypodermic injection of one-twentieth of a grain causes the pulse in twenty minutes to rise from 72 to 110, the mouth to grow dry, and the pupil to begin to dilate; there is giddiness with an inclination to sleep, and the dryness of the mouth and throat may last for twenty-four hours, with more or less nervousness and instability in walking (Harley).

The absorption of the active principle of belladonna by the skin was evident in the cases referred to below, in which the medicine was applied in the vicinity of the eye. Other cases are recorded of even more marked effects from a similar cause. Thus, Dr. Lyman states that having applied a belladonna plaster, measuring two inches by four, to the chest of a nervous female, it produced all the usual symptoms of poisoning by this substance, including a reduction of the pulse to twenty-eight in a minute. The symptoms continued in some degree during four or five days.[1] The phenomena, however, differ widely in different cases. Dr. Jenner states that a belladonna plaster, six by nine inches in size, having been applied to the loins of a man where the skin was affected with minute pustules and ulcers, he was seized with an urgent desire to urinate, and great loss of power in the lower limbs, while he articulated continually, but uttered no sound. The pulse was full and strong, and between 80 and 90.[2] A man whose neck was blistered for a laryngitis had the raw surface dressed with an ointment composed of three grains of atropia and two drachms of lard. In a few moments the patient was seized with severe pain, dyspnœa, and dysphagia, the pupils were widely dilated, the conjunctiva injected, and choreic movements affected all the limbs. The breathing became interrupted, the pulse thready, and the man died within two hours after the ointment had been applied.[3] A case is recorded in which belladonna poisoning was produced by applying a belladonna plaster upon the back where the skin had been excoriated by a previous plaster. In this case the characteristic symptoms were fully exhibited, and in addition a profuse scarlatinoid rash.[4] A very singular case in which a gentleman had nearly been sent to an insane hospital during the delirium produced by using an embrocation containing belladonna is related by Dr. Brown, and another by Dr. Fraser, in which a similar accident happened to a young woman who applied a belladonna liniment to her breasts.[5] Two analogous instances, in which a belladonna plaster caused the symptoms, are related by Mr. Morgan.[6] A case is reported in which a small dog, applied to the breast of a nursing woman who had taken a poisonous dose of belladonna, was instantly attacked with spasms.[7]

[1] Bost. Med. and Surg. Journ., Jan. 1857, p. 451.
[2] Times and Gaz., Nov. 1856, p. 513. [3] Annuaire de Thérap., 1867, p. 9.
[4] Brit. Med. Journ., May, 1872, p. 520. In this article an epitome is given of several analogous cases.
[5] Lond. Hosp. Rep., iii. 169, 171. [6] British Med. Journ., Dec. 1866.
[7] N. Y. Journ. of Med., Jan. 1854, p. 94.

Effects on the Nervous System.—A sense of tightness or pain is first felt in the frontal region and in the eyes, there is confusion of thought, with giddiness, a feeling of intoxication, and noises in the ears. The sight becomes confused, and objects are seen as through a mist, or they are mistaken for very different ones. Spectral illusions are not infrequent. They are usually of a pleasing character: images of diamonds and other precious stones, flashes of many-colored lights, birds of brilliant plumage, and insects with enamelled wings. Occasionally there is total blindness, even of several days' duration. The mind is agitated and excited by a train of extravagant ideas: there is often decided delirium, and nearly always of a gay description, which either prevents sleep entirely or permits only broken slumbers disturbed by fantastic dreams. It is remarkable that the patient may be quite conscious of his visual illusions and his delirium, but without having the power to prevent the one or control the other.

In certain cases familiar persons around the patient are not recognized, and are called by wrong names, the old and decrepit are addressed as young and beautiful, and even inanimate objects are mistaken for one another. This singular delirium has been compared to somnambulism. It is recorded of a tailor, who had used an injection of belladonna, that he remained on his shopboard for fifteen hours, sewing with great apparent earnestness, using all the gestures which his business requires, and moving his lips as if speaking, yet the whole of the time perfectly insensible.[1] Dr. Simpson mentions a lady who, under the influence of an overdose of belladonna, appeared as if in the act of dressing her hair for hours.[2] Some of the most frightful cases of suicidal and destructive impulse are declared to have had their origin in the use of belladonna, even where a predisposition to insanity did not exist. It is asserted that when tic douloureux has been suddenly stopped by belladonna, this form of madness was developed.[3] But, in general, poisonous doses of the drug give rise to active, and, for the most part, joyous delirium with laughter, running, etc., although there is in reality great loss of muscular power. A remarkable fact, observed in some cases of poisoning by belladonna, is the degree of anæsthesia which it produced. Of this a striking example is afforded by a man who swallowed, by mistake, an enormous dose of the watery extract of this plant. For several days the skin remained so insensible that it could be pinched or pricked without pain.[4] In most fatal cases, sopor succeeds delirium, or may even occur without being preceded by excitement; there is muscular relaxation, a red and tumid face, injection of the conjunctiva, and a frequent or else a very infrequent pulse. In some cases, convulsions are the immediate precursors of death. But in poisoning by belladonna narcotism is the exception, not the rule.

[1] Journ. of Psychol. Med., i. 304.
[2] Edinb. Monthly Journ., July, 1858, p. 79.
[3] Ibid., p. 303.
[4] Lond. Med. Gaz., June, 1848.

Effects on the Muscular System.—The vertigo produced by belladonna is accompanied by a remarkable disorder of the muscular system; the gait is unsteady and staggering, there is a sense of numbness in the limbs, with trembling, and jerking movements; the patient unconsciously runs against objects that are in his way, and on attempting to use his hands, finds that it is impossible to control their motions, or to seize small articles, and he is apt to catch at imaginary objects. The involuntary muscles are not less affected. The pupil is largely and immovably dilated, the eye is prominent and extremely brilliant; the voice is sometimes lost, or the sounds uttered are inarticulate; deglutition is difficult or impossible; there is often a singular difficulty in voiding the urine, which appears to be owing to a partial paralysis of the bladder; often involuntary discharges both of urine and fæces take place. There is sometimes complete paralysis of the *levator palpebræ superioris*, which has been known to continue for months. The dilatation of the pupil produced by belladonna and atropia is differently explained by experimenters; Dr. Harley ascribes it to a paralyzing power acting upon the ciliary branches of the third pair of nerves,[1] while Dr. Benjamin Bell concludes that it depends upon a contraction of the radiating fibres of the iris.[2] Mr. Wharton Jones also dissents from Dr. Harley's views,[3] and Dr. A. Fleming supposes that the medicine causes a contraction of the ciliary arteries, and prevents the turgescence of the iris with blood, while the radiating fibres "are drawn into action by functional sympathy with the contracted arteries."[4]

Effects upon the Circulation and the Secretions.—Belladonna in large doses sensibly affects the heart and bloodvessels. The pulse at first becomes slower, but afterwards is generally more frequent, and during the active stages of the operation bounding and full, but as the symptoms decline it falls again below the natural standard in strength and frequency, while in fatal cases, on the other hand, it grows rapid, intermittent, and thready. Dr. Gray[5] thus describes the effects of an overdose of the medicine upon himself, and confirms in nearly every particular the description of the best authorities. The eye was dry, "the conjunctival vessels fully injected. There was a total absence of lachrymation, and motion was attended with a sense of dryness and stiffness. The face was red and turgid, and the temperature and color of the surface considerably augmented." Schroff found the temperature, at first, uniformly lowered; but with smaller doses. In another case recorded by Dr. Gray, "the face, upper extremities, and trunk of the body exhibited a diffuse scarlet efflorescence studded with innumerable papillæ very closely resembling the rash of scarlatina." In himself "the pulse was full, and about 120 to 130. The feeling in the head was that of vio-

[1] Edinb. Journ., Dec. 1856, Feb. 1857; Times and Gaz., Jan. 1857.
[2] Edinb. Journ., July and Dec. 1856, and March, 1857; Times and Gaz., Jan. 1857, p. 107.
[3] Times and Gaz., Jan. 1857, p. 79
[4] Ibid., March, 1857, pp. 270, 345.
[5] N. Y. Journ. of Med., vol. v. p. 184.

lent congestion, a full, tense, throbbing state of the cerebral vessels, identically the same sensation as would be produced by a ligature thrown about the neck, and impeding the return of the venous circulation. . . . . The tongue, mouth, and fauces were as devoid of moisture as if they had been composed of burnt shoe leather. The secretions of the glands of the mouth, and the saliva, were entirely suspended. A draught of water, instead of giving relief, seemed only to increase the unctuous, clammy state of the mucous membrane. About the pharynx this sensation was most distressing. It induced a constant attempt at deglutition, and finally excited suffocation, and spasm of the fauces and glottis, renewed at every effort to swallow. A little saliva, white, and round like a ball of cotton, was now and then spat up. . . . . The power of belladonna over the secretion of urine seems very great. I am confident I passed in the course of an hour three pints of urine, accompanied with a slight strangury at the neck of the bladder." Irritation of the scrotum has been alleged to occur as an effect of the internal administration of belladonna. Böcker mentions a case in which a quarter of a grain of the extract, taken twice a day by a consumptive patient, produced, after the second dose, erythema and partial gangrene of the skin of the scrotum.[1]

The close resemblance which the symptoms of poisoning by belladonna bear to those produced by hyoscyamus dispenses with the necessity of analyzing the former, or of comparing them with the very different phenomena of narcotism from opium. They may all be produced as readily by the introduction of the active principle through the rectum, or the abraded cutis, as the stomach. The action upon the iris alone is manifested when a solution of the extract, or of atropia, is placed upon the conjunctiva, or is rubbed upon the sound skin around the eye; but in this case the effect takes place in that organ only upon or near which the application has been made, or, if the other is affected, it is so to a less degree and for a shorter time. In this case, as in many others, we have evidence of a medicinal action which may be almost entirely local, and is to be explained by the fact that the substance employed expends its force on the nervous and other tissues bounding the vascular capillary network which is placed between the arterial and the venous trunks. The effects of these local applications upon the sight are curious. A Scottish physician, Dr. Grieves, states that he has completely dispelled the phantasms of delirium tremens by merely rubbing the extract of belladonna upon the eyelids.[2] Donders has described under the name of *micropia* a condition of the eye, produced by the same cause, in which all objects appear to be smaller that natural, and similar cases have been reported by Warlomont, Cornaz, Sichel, and others.[3] Both pupils are dilated when a proper dose of the substance is taken internally, and this,

[1] Beiträge zur Heilkunde, ii. 305.
[2] Month. Journ. of Med. Sci., Nov. 1853, p. 430.
[3] Bull. de Thérap., liv. 427.

with dryness of the fauces, slight headache, and impairment of the vision, may be its only sensible effects.

The singular energy of *atropia* is shown by the following examples. Brandes tasted a minute quantity of sulphate of atropia, which he found more saline than bitter. He was seized with uneasiness in the head, trembling of the limbs, alternate chills and flushes of heat, and a violent and suffocative constriction of the chest. The pulse grew feeble, and the action of the heart almost imperceptible. The principal symptoms went off in the course of half an hour.[1] The following were observed by Schroff as the effects of five milligrammes, or seventy-seven thousandths of a grain taken *internally*. Headache in fifteen minutes; in thirty minutes a slight dilatation of the pupils; in forty minutes dry and hot hands and general formication; dryness of the fauces so as to impede deglutition. At first the pulse fell ten strokes, but soon rose, and in an hour and a half gained forty beats. The muscular movements were sluggish, the limbs tremulous, the gait unsteady. After an hour and a half the brain became excited, the movements were sudden and spasmodic, and the two experimenters, who were very peaceful persons, fell to wrestling and boxing. For three days afterwards the pupils remained dilated, the limbs weary, with a great disinclination to mental exertions and a sense of chilliness; the appetite and digestion were unimpaired. Dr. Percy[2] took $\frac{1}{10}$ gr. of sulphate of atropia in an ounce of water. In ten minutes nausea and unproductive retching occurred, followed by intense thirst and a frontal headache, dryness of the throat and mouth, and diminished frequency of the pulse which afterwards became smaller and more rapid. The sight grew indistinct (presbyopic), formication was felt in the back, arms, and back of the hands, and also in the throat; the eye was pained by light; in walking the floor seemed to recede from the feet, and the head dizzy. A recumbent position having been taken, the mind no longer distinguished real objects from hallucinations of sight, and there was a sort of double consciousness; "the actions were performed by others, and lengthy conversations of a most pleasant character were held with Plato, Alcibiades, Aspasia, and others. Profound sleep must have followed, for consciousness to external objects did not return till sixteen hours after taking the atropia. Awaking took place suddenly; there was no pain, no headache, nothing abnormal but a languor and disturbed vision."

In a case of long-standing neuralgia M. Delaye injected *subcutaneously* four milligrammes ($\frac{1}{15}$ gr.) of sulphate of atropia. Soon afterwards, on attempting to rise from her chair, the patient became giddy, fell, and then cried out, but immediately afterwards lost her voice, appeared to be blind, and quite delirious with grotesque hallucinations. Speech soon returned, but the delirium continued; clonic spasms of the limbs and of the muscles of the eyes took place,

[1] Trousseau and Pidoux, art. Belladone.
[2] New York Journ. of Med., viii. 254.

with extreme dilatation of the pupils, dryness and constriction of the throat; jerking respiration; cold and dry skin; and a wild expression.[1] In Dr. Harley's experiments the use of $\frac{1}{120}$ to $\frac{1}{100}$ gr. in this manner rendered the pulse more frequent as well as fuller and stronger; there was slight giddiness, and in delicate persons dryness of the mouth and throat, and after an hour or two slight dilatation of the pupil. The maximum dose which need ever be given in this manner, $\frac{1}{20}$ gr., caused the pulse to rise to 110; within twenty minutes the mouth grew dry and the pupils were slightly enlarged; there were giddiness and sleepiness, and the pulse descended to 108; no tendency to delirium, nervousness, or restlessness was exhibited; the skin remained cold and moist. At the end of two hours sleep occurred. The dryness of the mouth and throat continued until the next day. If larger doses are given there will be a fluttering sensation of the heart, no inclination to sleep, but pleasing illusions or delusions, the patient meddling with everything in his way, picking at and handling imaginary objects, with muttering and smiling, or with loud chattering and subdued laughter. There is an exquisite sensibility of hearing with frequent illusions of this sense; staggering, or complete inability to walk; insomnia, restlessness, and frequently great nervous agitation of mind and body. Nausea and headache are rare and exceptional consequences of the subcutaneous use of atropia. Insalivation and deglutition are almost impossible during the action of the drug; and dysury or complete retention of urine invariably follows the action of a full medicinal dose.

Fifteen milligrammes, or about one-fourth of a grain, of atropia applied to a freshly-*blistered surface*, excite acute pain, followed, in from fifteen to thirty minutes, by dryness of the mouth and fauces, inability to swallow, dilatation of the pupils, winking of the eyes, and heaviness of the head. To these symptoms succeed giddiness, confusion of sight and ideas, and a peculiar inability to steady the mind or to utter words corresponding with the thoughts; a sort of imbecile or loquacious delirium follows, the field of vision is filled with colored phantasms, and external objects appear yellow. The power of locomotion is sometimes lost, and the limbs feel as if asleep. General sensibility is impaired or destroyed, the respiration and circulation become slow, and the extremities are cold. Meanwhile consciousness may be perfect, although the inability to move is complete.[2] A case of fatal poisoning by sulphate of atropia, applied to the blistered skin, is reported by Ploss.[3] The salt was contained in an ointment, in the proportion of one part to about forty-seven of lard. The earlier symptoms were almost identical with those described above as due to the subcutaneous injection of atropia, but afterwards the pulse became very rapid and thready, the convulsions more constant, the respiration was interrupted, and

[1] Bull. de Thér., lxix. 236.
[2] Bouchardat, loc. cit. Grandi, Times and Gaz., Jan. 1855, p. 15.
[3] Bull. de Thér., lxviii. p. 230.

finally death ensued within two hours from the application of the poison. One drop of a solution which contained the thirtieth of a milligramme of atropia ($\frac{1}{5000}$ gr.) introduced *into the eye* occasioned a momentary burning, but no vascular injection. At the end of twenty or twenty-five minutes the pupil began rapidly to dilate, and in forty minutes scarcely any of the iris remained visible. At the end of forty-eight hours it had not entirely resumed its normal size. The sight of the eye, especially for near objects, was almost totally lost, but its irritability to light was increased. The opposite eye and the brain were entirely unaffected. Dr. Bethune reports that the greater number of these symptoms have ensued upon the application to the eye of a few drops of a solution containing two grains of atropia to a drachm of liquid.[1] A portion of it was doubtless absorbed through the nasal duct. Another example of this effect occurred in England ;[2] and still another in France, which was prevented from reaching a fatal termination, by the subcutaneous injection of morphia.[3]

The mode in which this medicine produces its effects is altogether unknown. Post-mortem inspection in some of the comparatively few cases of death resulting from its use, has revealed nothing which tends to throw light upon the subject. They have usually been cases of children poisoned by eating belladonna berries. Mr. Taylor reports the case of a man who was found dead in bed after taking two grains of atropia. His limbs were rigid and contracted, and a little brown matter issued from his mouth. Congestion of the cerebral bloodvessels, fluidity of the blood itself, bloody effusion into the ventricles, accumulation of blood in the lungs and heart, some reddish patches upon the mucous membrane of the pharynx and stomach, these are the only lesions which have been discovered after death, and are evidently inadequate to explain the symptoms produced by belladonna. Böcker, indeed, describes its operation as chiefly a moulting, or increased waste, of the blood-corpuscles and of the nervous centres ; but of these processes we possess very indistinct ideas. Two fatal cases of more recent occurrence may here be referred to.[4] The one relates to a lad of 16, the other to a woman of 66. The one swallowed a drachm of the extract, the other "a teaspoonful of belladonna liniment." The symptoms consisted of agitation followed by coma, and death took place in 3½ hours in the first case and in the second in about 16 hours. In both the skin was discolored after death, the brain not strikingly congested, the lungs were gorged with blood, and the left side of the heart was empty, while the right contained some dark but not fluid blood. These results, it will be observed, do not exactly coincide with those in the case first cited.

Remedial Employment. *Tumors.*—It was before stated that the reputation of belladonna was originally due to its supposed

[1] Boston Med. and Surg. Journ., April, 1857, p. 201.
[2] Assoc. Med. Journ., Sept. 1853, p. 818.
[3] Bull. de Thér., lxxii. 91.
[4] British Med. Journ., Nov. 1869 ; Lancet, July, 1870, p. 83.

resolvent powers in cancerous diseases. But for nearly a century physicians have ceased to attribute to it any such virtues, and it is now agreed that imperfect skill in diagnosis must have led to the erroneous belief referred to. Still there can be no doubt that tumors of some kind did get well apparently under the use of belladonna, nor will the mere anodyne properties of the medicine fully account for its imputed success. From a limited observation we are disposed to believe that in addition to this quality, of itself favorable to resolution, both belladonna and stramonium possess a real efficacy in discussing glands enlarged by chronic inflammation. Evers, Autenrieth, Dalruc,[1] and Chevalier[2] have given very decided testimony in favor of its resolvent powers in engorgement of the breasts, and in scrofulous tumors and swellings of the joints; they employed it both internally and externally. We know of no well-attested instances of its causing the removal of genuine tumors, even of the benign species. It is possible that the curative effects formerly attributed to belladonna in open cancer may be accounted for by its drying influence or astringency, which has been more recently dwelt upon by Mr. Ley.[3] He says: "Various vesicular eruptions on the skin are removed by it, and when the contents of the vesicle have become semi-purulent, the true skin ulcerated, the ulcer being deep and devoid of healthy granulations, the edges being under the influence of the creeping vesicle, a single grain of the extract of belladonna will annihilate the eruption, and the ulcer will immediately assume a healthy appearance."

Neuralgia.—Belladonna as an internal remedy for neuralgia appears to have been first employed by Dr. Bailey,[4] who reported sixteen cases observed by himself in which the trigeminus nerve was severely affected, and which were either greatly relieved or permanently cured by the extract of belladonna given in doses of one grain every sixth hour, or oftener when the pain was intense. M. Trousseau, after remarking that it has frequently been employed successfully in the treatment of neuralgia, states that his mode of administering the extract for this affection is to direct one-fifth of a grain to be taken every hour, until vertigo is produced. The frequency of the doses is then to be diminished, but their impression ought to be maintained for several days, or until no trace of the attack remains. The success achieved by Dr. Bailey does not appear to have created many imitators of his practice either in England or in this country, although it has long been in vogue upon the continent of Europe. Indeed, so lately as 1843, Dr. Hutchinson, of Nottingham, Eng., spoke of the method as a new one in his own country, and adduced seven cases of well-marked facial neuralgia in which it alone effected a cure.[5] Dr. Hutchinson prescribed the extract of belladonna three times a day, beginning

[1] Eberle, Therapeutics, p. 364. [2] Lond. Med. and Phys. Journ., 1826.
[3] Lancet, 1844, vol. i. p. 542.
[4] Observations relative to the Use of Belladonna in Painful Disorders of the Head and Face. London, 1818.
[5] Lancet, 1842–43, vol. ii. p. 830.

with one-quarter of a grain and gradually increasing the dose to one grain, or until the iris betrayed the specific influence of the medicine. Other forms of neuralgia do not appear to be nearly as much as the facial variety under the control of belladonna internally administered; while all forms of the disorder have been found to yield to the application of this remedy upon the unbroken skin, when the affected nerve is superficial, and to its contact with the derm, when the nervous trunk is deep seated.

Frictions with a solution of belladonna (sixty grs. of the extract to ℥j of water) were first used successfully in *sciatica* by Dr. Todd,[1] and more recently Hiriart,[2] Hutchinson,[3] and others have employed different preparations. When, according to M. Hiriart, the affected limb is rubbed in its whole length, and several times a day, with an ointment composed of one part of extract of belladonna to two of lard, a pricking sensation is experienced, and slight symptoms of cerebral disorder, which are speedily followed by an abatement of the pain. Dr. Hutchinson, and most others, denuded the cutis by means of a long narrow blister over the course of the sciatic, or the anterior crural nerve, as the case might be, and dressed it with an ointment composed of one-eighth, or less, of the extract to one part of lard. In the cases of success reported by the gentlemen just named, the part of the blister in the cure is not sufficiently considered, as will be seen on referring to the article CANTHARIS. So far as relates to the local influence of the anodyne, it may probably be obtained without vesicating a large portion of the limb. Small blisters applied over the superficial trunks and terminal branches of the painful nerve, and dressed with a strong ointment, would, there is reason to believe, be found amply sufficient to attain the object in view. In obstinate cases of sciatica which have resisted the plan already indicated, an expedient remains which has been found successful by Trousseau and others. This consists in establishing an issue between the tuberosity of the ischium and the great trochanter of the thigh-bone, and dressing the sore with the extract of belladonna. The writer just named does not hesitate to make the issue by means of an incision carried down to the subcutaneous adipose layer, and to promote suppuration by means of a ball composed of extract of belladonna and opium. The quantity of the extract applied upon a blistered surface ought not to exceed six grains.

Since the introduction of atropia, this alkaloid has been used by *subcutaneous injection* in affections of a painful character, and especially for the relief of neuralgia. This mode of employing the medicine excels all others in the promptness and certainty of its effects. The form of neuralgia most rebellious to it as to all other modes of treatment is sciatica, and yet there is probably none other which more frequently triumphs over this obstinate and painful affection. Thus, while Mr. Béhier found that one or two subcu-

[1] Arch. Gén. de Méd., 1ère série, vol. viii. p. 272.
[2] Bull. de Thérap., vol. xxii. p. 52. [3] Lancet, 1843–44, vol. i. p. 53.

taneous injections of sulphate of atropia were sufficient to cure intercostal neuralgia, as many as three and even ten or fifteen were necessary to remove sciatica. It is to be regretted that the published reports of cures by this method contain so few cases of facial neuralgia. According to Dr. Harley, "in painful affections of the nerves" it is "the most valuable remedy that we possess." "In my hands," he adds, "it has never failed to bring relief, and in all cases but one it has finally removed the affection." In all cases of the subcutaneous injection of atropia a development of the specific effects of the medicine must be expected. Within fifteen or twenty minutes the sight becomes hazy, the head giddy, and the throat dry. It is usual in this country and in England to inject from five to ten minims of a solution containing one grain of sulphate of atropia to a fluidounce of distilled water. Five minims will contain one ninety-sixth of a grain of the salt, and ten minims one forty-eighth of a grain.

Belladonna is often employed as a topical anodyne application in other than neuralgic pains. Reference has already been made to its usefulness in discussing tumors by diminishing their sensibility, and that of the adjacent parts. It has been used successfully to facilitate the introduction of *bougies* into the urethra when this canal is strictured and irritable, by covering them with the ointment or extract. In *fissures*, and other painful affections about the *anus*, an ointment of belladonna, either alone or associated with galls or lead cerate, is of signal advantage. *Toothache*, *earache*, *rheumatism of the muscles or joints*, in fact every local painful affection, may be palliated by a due application of this anodyne. The extract may be mixed with oil, alcohol, or water for the purpose of friction, or may be more permanently applied in cataplasms or plasters. These external uses of the remedy are not always without danger. Dr. J. C. Williams relates that he has known impaired vision and partial hemiplegia to result from rubbing a solution of the extract upon the forehead of a lady;[1] a case in which a lady of this city had the pupils dilated and the sight impaired, by a similar application, has come to the knowledge of the author; and Mr. Wade reports a case of poisoning by a belladonna plaster not more than two inches square applied over an eruption of psoriasis on the front of the wrist.[2] These instances, and other analogous ones mentioned in the present article, prove that an extraordinary susceptibility, which the practitioner should be aware of, exists in certain cases to the action of belladonna. The danger to life may not, indeed, be very great; but it is always desirable to avoid the alarm and distress which accidents of the sort occasion.

Another occasion for the local application of belladonna is presented by one form of that painful and troublesome affection known as *irritable uterus*, and which is often a neuralgic condition of the organ. It may be successfully combated by using a vaginal injection of the extract dissolved in water, three or four times a day;

[1] Lancet, 1844, vol. i. p. 251. [2] Journ. des Prog., vol. iii. p. 235.

or, according to M. Trousseau, when accompanied with ulceration of the os uteri and with leucorrhœa, by means of one or two grains of the extract along with six or eight of powdered tannin, rolled in cotton wadding, and placed in contact with the affected part. The wad of cotton should be secured by means of a thread, accessible from without, and be freshly applied every night, after cleansing the passage with a detergent injection.[1]

Spasmodic Diseases.—Belladonna has been lauded as a valuable antispasmodic for several affections in which the state of spasm, if it exist at all, is subordinate entirely to the element, pain. These cases may be disposed of first.

Spasm of the sphincter ani muscles, when the adjacent parts are ulcerated or irritated, is well known to be excruciatingly painful. As already mentioned, belladonna relieves the pain of this disorder, and by so doing prevents or moderates the spasm which results from it. Dupuytren first employed this remedy in an ointment combined with acetate of lead, and presumed that its efficacy depended upon its direct power of preventing constriction of the sphincter.[2] But the dependence of the latter symptom itself upon the morbid sensibility of the bowel is now proved by the power of simple astringents to cure fissures of the anus.

Spasm of the urethra is also stated to have been overcome, so as to permit the escape of calculi from the bladder, by means of frictions with extract of belladonna, upon the perineum.[3] Here it is evident that the remedy must have been mainly operative through its power of diminishing the irritability of the passage, which, when excited by the presence of the calculus, induced a spasmodic tension of the urethral muscles.

If any further proof were necessary of the correctness of this view, it might be discerned in the efficacy of belladonna as a remedy for nocturnal *incontinence of urine.* Morand,[4] Trousseau, Blache, Bretonneau, Brooke,[5] Hutchinson,[6] A. Hewson, Condie,[7] and Hughes,[8] have found it very efficient in curing this disgusting infirmity, which it certainly cannot do by virtue of any *relaxing* power it may possess. It blunts the sensibility and allays the spasm of the neck of the bladder, and thus prevents the call of nature until a due amount of urine has accumulated.[9] Two cases are reported which strikingly illustrate this mode of action. In both the patients were sixteen years old, both had suffered the infirmity from infancy, and in both there was neither vesical, urethral, nor any other irritation, nothing but a simple loss of power of the sphincter of the bladder. Both were promptly cured by tinc-

[1] Op. cit.
[2] Bull. Gén. de Thér., vol. i. p. 187. PEIRANO, Monthly Journ. of Med. Sci., March, 1852, p. 276.
[3] MOJON, of Genoa, and ABERLE, Annales de Thér., vol. iii. p. 40.
[4] Journal de Médecine, 1845, p. 345. [5] Times and Gaz., Feb. 1858, p. 114.
[6] RANKING's Abs. (Am. ed.), xxv. 196.
[7] Am. Journ. of Med. Sci., Oct. 1858, p. 387 and 392.
[8] BRAITHWAITE's Retros. (Am. ed.), xlii. 298.
[9] Am. Journ. of Med. Sci., vol. xxxiii., N. S., p. 186.

ture of belladonna in doses of fifteen minims taken at bedtime.[1] A case of whooping-cough is recorded in which the medicine caused a cessation of erections of the penis during the whole period of the treatment.[2] As a frequent cause of these occurrences is irritation of the neck of the bladder, we may presume that by calming this irritation the remedy prevented its effects. In like manner Lepri, and after him Trousseau, have successfully treated *spermatorrhœa*, employing the remedy both locally and internally.[3]

A similar explanation ought probably to be given of the relief obtained from belladonna in certain cases of *dysmenorrhœa*. Dr. Golding Bird[4] found the remedy very efficacious when there was no organic disease of the uterus, but shreds were discharged at the menstrual period, and severe pain was experienced at the same time in the hypogastric region. When the patient is anemic or leucophlegmatic, one-fourth of a grain of extract of belladonna with one grain of sulphate of zinc may be given every two or three hours until the pain ceases. For plethoric patients ipecacuanha is more suitable than sulphate of zinc. Between the catamenial epochs, purgatives should be administered, and other means taken to improve the general health. Bretonneau employed belladonna topically under similar circumstances. In estimating the value of this treatment, the fact must not be lost sight of that in dysmenorrhœa with fibrinous clots, the pain often ceases abruptly when at its worst, upon the discharge of the distending coagulum from the womb. The mechanism of pain caused by the passage of biliary and renal *calculi* is very like the uterine pain just considered, and belladonna is equally beneficial in allaying it.

Cases are reported by various authors[5] to prove the antispasmodic virtues of belladonna in *phimosis* and *paraphimosis*, although, as must be evident upon the least reflection, the stricture in these affections is a mechanical result of inflammation, and in nowise of spasm, since there are no tissues concerned which are susceptible of spasmodic action. On examining the cases on record, it appears certain that the local pain is a chief cause of that afflux of blood which maintains the morbid state of the penis, and that the alleviation of this symptom permits the parts to return to their natural condition, under proper manipulation.

Trousseau declares belladonna to be the remedy *par excellence* for habitual *constipation*. It does not purge, but only renders defecation easier, and sometimes in the dose of a quarter of a grain the extract will produce several solid stools. The extract may be given in doses of one-sixth of a grain to two-thirds of a grain every morning on rising. As soon as the bowels become regular the dose of the medicine should be gradually diminished.[6] Cases illus-

[1] Lancet, Oct. 1870, p. 563.
[2] New Orleans Med. and Surg. Journ., 1858.
[3] Bull. de Thérap., xlvi. 235; xlviii. 189. [4] Lancet, 1844, vol. i. p. 27.
[5] Amongst others, by MAZADE, Bull. Gén. de Thér., vol. vii. p. 67: MIGNOT, ibid., vol. xx. p. 260; CHABRELY, ibid., vol. xxiii. 319.
[6] Abeille Méd., xi. 112.

trative of the efficacy of this treatment are reported by Fiessenger, who, however made use of suppositories containing the extract of belladonna,[1] by Blache,[2] and by Fleury.[3] A similar approbation of the medicine is expressed by Leared,[4] by Wilson Fox,[5] and Dr. F. B. Nunneley;[6] and Fleming, explaining the supposed efficacy of the medicine by its constrictive action upon the gastro-intestinal capillaries, conceives that this action, rendering the mucous membrane dry, exposes it thus unprotected to the irritation caused by the contents of the intestine, by means of which the bowel is stimulated to contraction.[7] This hypothesis is inadmissible; since, if we know anything of the operation of opium, it is that it promotes constipation by the very same action which is here attributed to belladonna to explain its power of removing constipation.

The alleged efficacy of belladonna in procuring the reduction of *strangulated hernia* rests upon very slender evidence; admitting it, however, to be proven, the inference is not that it acts by overcoming spasm, since the cause of the strangulation is swelling of the protruded part. We may more plausibly conjecture that the sedation of pain, and the contraction of the arteries caused by the anodyne allay the congestion of the bowel, and so render its reduction practicable. In the cases of reported success to which reference is made below, belladonna was administered by the rectum, or applied over the hernial tumor.[8] According to Mr. J. W. Curran, tincture of belladonna is a sovereign remedy for infantile *jaundice.* He supposes it to act by relaxing the bile ducts, and affirms that after its administration the child ceases crying, falls asleep, "passes bile freely by the bowels," and rapidly recovers its natural state and condition.[9] In truly spasmodic affections, or those in which there is abnormal, and, for the most part, paroxysmal muscular contraction, belladonna has been extensively and beneficially employed. In *rigidity of the os uteri* during labor, this remedy was first recommended by Chaussier as a local application. He, as well as several other writers,[10] have testified to its virtues in overcoming this annoying incident of parturition; but both depletion and nauseants afford a so much readier resource, that they will probably continue to be preferred to a means which it is neither easy nor agreeable to apply. There is more reason to believe that belladonna excites uterine contractions. Dr. Brown-Séquard concludes from his experiments that its action upon unstriped muscular fibres is identical with that of ergot, and states that it has been practically employed to produce contraction of the uterus. This property associated with its anodyne action appears to be sufficient for explaining the greater number of its remedial applications.

[1] Charleston Med. Journ., xi. 266.
[2] Annuaire de Thérap., 1849, p. 43.
[3] Archives Gén. de Méd., Mars, 1838.
[4] On Imperfect Digestion, 4th ed., p. 184.
[5] Dyspepsia, p. 221.
[6] Practitioner, iv. 217.
[7] Brit. Med. Journ., Dec. 1866.
[8] De Larne, Br. and For. Med.-Chir. Rev., July, 1857, p. 238; Burgatti, Bull. de Thérap., liii. 191; Thibeaud, ibid., p. 380; Hermier, Abeille Méd., xiv. 251, 311; Chrestien, ibid., xix. 522.
[9] Med. Press and Circular, Sept. 1868.
[10] Soma, Bull. de Thérap., xlvi. 547.

Whooping-Cough.—Although previously employed in the treatment of this disease, belladonna was first systematically used to cure whooping-cough, by Schaeffer and Wetzler, in 1810;[1] the latter treated thirty children, all of whom were cured, between the eighth and fifteenth day after beginning to take the medicine. He found the most favorable period of the disease for commencing the treatment was between the sixteenth and twentieth days, and the proper dose to be a quarter of a grain of the root, morning and evening, for a child under one year of age. These results were confirmed by many writers, and particularly by Meglin, and Kahleiss, in 1827.[2] Several years later, Dr. Samuel Jackson, then of Northumberland, Pa.,[3] prescribed the remedy in numerous cases of whooping-cough, and with complete success, directing fractional parts of a grain of the extract at intervals of three hours, until dilatation of the pupil took place, when the medicine was omitted altogether, or given in smaller doses. This treatment was preceded by antiphlogistic measures. Constant, in presenting a summary of his observations at the Children's Hospital, in Paris, in regard to the treatment of whooping-cough, gives the preference to belladonna over all other means; and his report shows substantial ground for this preference, inasmuch as the progress and decline of the disease corresponded with the suspension and resumption of the remedy.[4] Dr. Thompson, of London, bears a similar testimony upon this subject. M. Fuster, professor in the University of Montpellier, employed the vapors of an infusion of belladonna leaves by inhalation, and with uniform success,[5] and Dr. Caldwell states that the inhalation of an atomized solution of the fluid extract (gtt. iij. @ gtt. v to ℥j), promptly mitigates the spasmodic cough.[6]

Dr. Corson, of Norristown, Pa., says: "During the last seventeen years, I have given the extract of belladonna to hundreds of patients, from two months to fifty years of age, and am firmly convinced that it has greater control over whooping-cough than any other remedy in common use."[7] Many observers have found it almost inefficacious at the commencement of an epidemic, but very successful during its decline. Ingmann states, that under such circumstances, it far surpasses all other medicines.[8] MM. Rilliet and Barthez do not appear to have made use of it, but they call attention to the fact that Wendt and Goelis have both seen mischievous consequences result from its use.[9] No other writers allude to such effects, except as following an injudicious exhibition of the medicine, or the omission to suspend it when dilatation of the pupil comes on; even these disquieting symptoms are stated to have been temporary.

[1] Dict. des Sci. Méd., vol. iii. p. 74.
[2] Am. Journ. of Med. Sci., vol. vi. p. 238.
[3] Ibid., vol. xiv. p. 364.
[4] Bull. de Thér., vol. vi. p. 230.
[5] Ibid., vol. vii. p. 139.
[6] Boston Journ., April, 1871, p. 259.
[7] Am. Journ. of Med. Sci., Oct. 1852, p. 357.
[8] Journ. f. Pharmacodynamik, 1 Bd., 3 H., p. 312.
[9] Mal. des Enfans, vol. ii. p. 337.

The mode of administration advised by Bretonneau is as follows: A child of five years should take immediately before breakfast, for two days, a pill containing one-twelfth of a grain of the extract; if no effect is observed by the third day, the dose should be raised to one-eighth of a grain. On the fifth day the same dose, and on the eighth day, if no effects are produced, one-third of a grain may be given, and continued for three days, or gradually increased until the pupils are affected, or the cough declines; at that point the dose should, for a time, remain the same.[1]

M. Trousseau mentions insomnia as apt to be produced by belladonna in this disease, whence he usually prescribes opium in combination with it. It is more than probable that the opium neutralizes the antispasmodic virtues of the belladonna, as well as its tendency to occasion wakefulness. We have had under treatment cases of whooping-cough which were distinctly palliated when the extract of belladonna was taken, and aggravated when it was withheld. On the whole, it would appear that belladonna is positively curative in whooping-cough which has passed the inflammatory stage, but that, in certain epidemics, it has signally failed in the hands even of those who have before prescribed it with success.

Belladonna applied to a blistered surface appears to have been promptly and completely efficient in some cases of *laryngitis* which displayed more or less of a spasmodic element;[2] and as an internal remedy for *nervous coughs*, especially for those which, independently of any local disease of the respiratory apparatus, disturbs the rest at night by their persistence and violence.

Tetanus.—Several cases of traumatic tetanus are reported by Dr. Hutchinson,[3] as having been cured by extract of belladonna. Only one of these presents the requisite proofs of the efficacy of the remedy employed. In it, Dr. Hutchinson informs us, the specific action of the medicine upon the pupils was attended with an abatement of the spasms, but the improvement did not advance until the dose was increased from half a grain or a grain of the extract every three hours, to four grains every two hours. It was then gradually diminished. The treatment lasted about one month. Vial relates three cases of cure by this medicine,[4] and others are reported by Ernst.[5] In the idiopathic form of tetanus, also, belladonna is alleged to have brought about a cure. A striking example of cure in such a case is reported by Lombard. A hypodermic injection of $\frac{1}{22}$ grain followed by another of $\frac{1}{16}$ grain of atropia subdued the symptoms after other means had failed.[6]

In *poisoning* by *strychnia* the medicine exhibits a similar control over the tetanic spasms. In a case of attempted suicide by this substance in which the spasms were very severe, an immediate

[1] Bull. de Thérap., 1856, p. 28.
[2] Shelton, Am. Journ. of Med. Sci., April, 1858, p. 340.
[3] Lancet, 1844, vol. i. p. 274.
[4] Bull. de Thérap., March, 1843.
[5] Ibid., li. 431; lii. 554.
[6] Ibid., lxxv. 134.

mitigation of them was occasioned by a hypodermic injection of atropia. Three doses, each of $\frac{1}{6}$ grain were given at intervals of ten minutes, and subsequently less frequently, until $1\frac{1}{6}$ grain of atropia had been used. The tolerance of the medicine was not less remarkable than its control over the symptoms.[1]

Epilepsy.—The attention of practitioners was called by M. Débreyne, in 1842, to the remarkable results of his treatment of epilepsy by belladonna, which, upon the evidence of two hundred cases, he regards as the most efficient remedy hitherto proposed for this terrible disease.[2] Even where a cure did not ensue, the violence and frequency of the attacks were singularly diminished. It would seem that recent cases are chiefly, if not exclusively, those which it favorably affects; for after an extensive and faithful trial of the medicine upon numerous chronic cases in the Bicêtre, M. Delasiauve found that in one instance alone did even a probable cure take place.[3] Nor has any other writer done much more to confirm the statements of Débreyne, and of several German authors who claimed an equally remarkable degree of success. To those who desire to test this method, it may be interesting to know the best mode of prescribing the drug. Sixty grains of pure extract of belladonna are mixed with some inert powder, and divided into one hundred and twenty pills, of which one is taken the first day, two the second, and so on until six are taken in the twenty-four hours. If the sight remains unaffected, the dose may be daily augmented by two pills, until ten or twelve are taken in every twenty-four hours. This quantity should continue to be given for two or three months, and after being suspended for a week, the medicine is to be resumed in a somewhat smaller dose, and again increased gradually. According to M. Trousseau, "this course should be persisted in for three or four years;" and he remarks, appropriately enough, that "patient and physician must rival one another in perseverance." M. Trousseau is reported to have treated a hundred and fifty epileptic patients according to a similar system, and of this number to have cured twenty.[4] Michéa states that with valerianate of atropia he effected three cures.[5] It may be inferred from the preceding statements, that belladonna deserves to be tried in cases of epilepsy dependent upon disordered function merely, a statement which Dr. Harley confirms. According to Dr. Echeverria, belladonna is more active in the epilepsy of children than of adults, and is valuable mainly in vertiginous epilepsy, or when the two forms of epileptic attacks are combined. Otherwise, he remarks, "I have pushed belladonna to the highest possible doses in ordinary convulsive fits, without in any way obtaining any reliable results."[6] To this estimate of the medicine we are disposed to subscribe.[7]

Nervous Vomiting in Pregnancy.—This distressing disorder is very

[1] Edinb. Med. Journ., xix. 211.
[2] Bull. de Thérap., vol. xx. p. 272.
[3] Ann. de Méd. Psychol., vol. x. p. 47.
[4] Bull. de Thérap., l. 375.
[5] Ibid., 193.
[6] On Epilepsy, p. 307.
[7] Comp. Practitioner, vi. 121; Prager Vierteljahrs., cviii. Anal. p. 95.

generally regarded as altogether intractable, but of late years, several of the anæsthetic class of narcotics have been found successful in relieving it. In 1842, M. Bretonneau proposed the treatment with belladonna in the form of an ointment, or of a paste made by mixing its extract with the extract of rhatany and water. This he directed to be rubbed upon the epigastrium two or three times a day for five or ten minutes. It is remarkable that the internal administration of belladonna had no effect upon the vomiting, while frictions with the same medicine uniformly arrested it.[1]

Spasmodic Asthma.—In that form of asthma in which, whether connected or not with pulmonary emphysema, the dyspnœa is paroxysmal, and there is little or no bronchial secretion, belladonna has been found extremely serviceable. Lenhossek regarded it as a specific in this affection, and Magistel employed the vapors of a watery infusion successfully by inhalation.[2] Mingled with tobacco and smoked, its action is even more prompt and decided. According to Dr. Harley, in asthma originating in peripheral or centric nervous irritation, the subcutaneous use of atropia is often followed by speedy and long-continued relief. Dr. Salter probably assigns the true reason for the relative want of appreciation of this remedy: it has not been given in large enough doses. Like all of its class, its curative effects are seldom manifested except as a consequence of its sensible effects. The dose must be gradually increased until the characteristic phenomena begin to appear. It should be administered in the evening, as a general rule, so as to anticipate the usual time of the paroxysm.[3]

Paraplegia due to Myelitis.—Several physicians have from time to time reported cases of paralysis, and especially of paraplegia, cured by belladonna, but Dr. Brown-Séquard has brought this treatment into bolder relief by proposing a rational explanation of its mode of action. Experiments upon animals led him to the conclusion that belladonna is a powerful excitant of unstriped muscular fibres in the bloodvessels, iris, etc., and hence that it tends to limit the afflux of blood and the consequences of congestion in the parts upon whose bloodvessels it specifically acts. One of these parts he has experimentally determined to be the spinal marrow, and the practical success of the treatment confirms his judgment. Associated or not with ergot, which he holds to possess an analogous power, this medicine has, in his hands, been the means of effecting numerous cures of inflammatory paraplegia. At first he usually prescribes ergot alone, internally in doses of two or three grains twice a day, and extract of belladonna as a plaster to the spine, but afterwards internally in doses of a quarter of a grain twice a day. After six or eight weeks of this treatment, if the patient does not get better, he prescribes iodide of potassium in doses of

[1] Bull. de Thérap., vol. xxxi. p. 130.
[2] Szerlecki, Dict. de Thérapeutique, tom. ii. p. 204.
[3] Lancet, Jan. 1869, p. 152.

five or six grains twice a day in addition to the preceding remedies.

Diseases of the Eyes.—The dilatation of the pupil observed in poisoning by belladonna would naturally suggest the employment of this agent for facilitating several operations upon the eye, and for remedying some of its diseases. An accidental notice of the phenomenon alluded to, in a lady who had washed her eyes with an infusion of belladonna, was, however, the starting-point of the experiments performed by Himly, in 1801, and which led to the employment of this valuable adjuvant in ophthalmic surgery.[1] There is, perhaps, except the other mydriatics, no other single remedy capable of rendering such important services in this department of the healing art. In the first place, it is used for the purpose of obtaining a distincter view of the parts posterior to the iris, than is possible when the organ is examined under a diminished light alone. By its means, therefore, the quality of a cataract may be determined, and whether or not adhesions exist between the uvea and the capsule of the lens; the movements of the needle can also be kept in view during operations for cataract. Under its influence, moreover, morbid adhesions of the iris may be broken up, and abnormal positions of this organ corrected.

To prepare a cataractous eye, the extract of belladonna, moistened to the consistence of cream, may be smeared upon the brow and eyelids over night, and washed off with a little tepid water a few minutes previous to the examination or operation. Still better, a drop of a solution of one grain of atropia in f℥v of alcohol and as much distilled water may be introduced into the eye. When either depression or division of the cataract is proposed, this preparation ought never to be omitted; there is some doubt of its propriety when the lens is to be extracted, because in that case the vitreous humor may escape. On the other hand, dilatation of the pupil renders the extraction of the cataract less difficult, and diminishes the danger of wounding the iris, and consequently the effects of iritic inflammation. Besides, as Himly long ago remarked, the susceptibility of the patient's pupil to the action of belladonna may be carefully ascertained beforehand, and no more of the medicine employed than is requisite to produce a moderate degree of dilatation.

An equally important and more frequent occasion for using belladonna is in *iritis*, in order to prevent unnatural adhesions of the iris. According to Mackenzie, and indeed all the best authorities, it ought to be employed in every case, and in all stages of the disease.[2] It may be applied in the manner above mentioned, or a filtered aqueous solution of the extract, or one of atropia, dropped into the eye; and this should be done especially in the evening, since the disease advances most rapidly at night. Even when the effused fibrin is not absorbed during the continuance of the dilatation, the

[1] Bayle, Bib. de Thér.
[2] A Practical Treatise on the Diseases of the Eye, 2d ed.

iris is at least prevented from contracting adhesions, and, by restraining its natural movements, one obstacle more to the success of subsequent treatment is removed. The earlier in the attack the remedy is administered, the surer will be its success; yet, even after the plastic exudation has acquired considerable tenacity, the steady and prolonged use of belladonna has been known to overcome its hold. It has been plausibly suggested that the usefulness of belladonna in iritis depends not only on its power of dilating the pupil, which also implies contracting its bloodvessels, but in addition holding the inflamed organ in a state of immobility and thereby preventing its irritation.

In *hernia of the iris* through an ulcer of the cornea the same means may be successfully invoked. Opacity of the cornea, when circumscribed and opposite the pupil, and central cataract in like manner, may be prevented from altogether obstructing the entrance of light into the globe, while the pupil is kept moderately dilated by belladonna. Knavery has made use of this fact to impose upon persons affected with cataract and almost totally blind. A few drops of a solution of belladonna, instilled into the eye, has restored momentary vision to the unhappy dupes, as if by a miracle, and at the same time blinded them effectually to the trick which was played upon them.

The various effects which have been enumerated are very rapidly and decidedly produced by *atropia*. One grain of this substance, dissolved in a fluidrachm of water, furnishes a solution of which a single drop, placed upon the conjunctiva, will in from five to fifteen minutes dilate the pupil of the healthy eye to double or more than double its ordinary medium size, and retain it so during four or five days.[1] It is prudent to apply it with a fine camel's hair pencil at the external canthus of the eye. If too liberally used it may reach the fauces and occasion poisoning. Mr. Wilde used solutions of double or triple the strength mentioned when it was desirable to procure the complete and permanent dilatation of the pupil, but resorted to the simple extract of belladonna when a more moderate and temporary effect was sought, as in examining the eye for cataract. The action of belladonna and of atropia upon the eye is explained by Dr. A. Fleming[2] as follows: "It reaches, first, by imbibition, the arteries entering the iris—constricts them—impedes the flow of blood to and relaxes its tissue. The constriction of the arteries of the iris, with its consequent relaxation, draws into action, by functional sympathy (and without the intervention, by reflex action, of the brain or cord), the radiating fibres, and dilates the pupil." The changed power of vision is thus accounted for: "Sinking deeper into the eye the alkaloid reaches, secondly, the ciliary processes, and relaxes the erectile structure, and causes distant vision. The relaxation of the ciliary body must cause the advance and expansion of the vitreous humor around the lens,

[1] Mr. Wilde, Dublin Quart. Journ. of Med. Sci., Nov. 1846.
[2] Edinb. Med. Journ., ix. 777.

while the lens itself recedes to occupy the place of the displaced fluid."

Intolerance of light which follows operations upon the eye, or accompanies neuralgia of this organ, is much less certainly relieved by the local application of belladonna, or even by the stronger solutions of atropia employed by Mr. Wilde. Internally administered, however, the medicine promptly alleviates photophobia. Yet the necessity for the latter mode of exhibition is not altogether absolute; for in perhaps the first instances in which belladonna was employed to relieve excessive sensibility to light, the extract was applied around the orbit. The cases alluded to, six in number, were of acute and chronic conjunctivitis, and were treated by Lisfranc in 1826.[1]

To Arrest the Mammary Secretion.—Belladonna was long ago used as a resolvent for tumors of the mamma by Alberti, Zimmermann, Autenrieth, and others, and Evers recommended it in cases of milk abscess and induration. In 1829 Ranque used a liniment of laurel-water, ether, and belladonna, with great success, in drying up the milk;[2] and Schnur published several examples of its utility in similar cases.[3] It was not, however, mentioned by subsequent writers on the diseases of females, nor by others, until, in 1856, Mr. Goolden reported his successful use of it in arresting the secretion of milk.[4] His statement was speedily confirmed by Dr. Willey, of St. Paul, Min.,[5] Mr. Burrows, of Liverpool,[6] Drs. Harris, of Ottawa,[7] Bacon,[8] Blythman,[9] Mr. Newman,[10] and others. The last-named gentleman reported success in more than a dozen cases, in which no purgative or other auxiliary treatment was employed. Some assert that it promotes the flow of milk, while it relieves tension and pain;[11] but others explain this occurrence as the first step towards cure, the milk being ultimately dried up.[12] Dr. Spring has suggested that in many of the reported cases the subsidence of the inflammation was spontaneous, because he found the remedy quite ineffectual in true "galactorrhœa."[13] The general coincidence of results obtained by the treatment in question, and the rapidity with which they are said to have been brought about, appear to render this objection inadmissible. Mr. Richard Hughes has propounded an explanation of the fact in question which harmonizes with the present doctrines regarding the nervous system and the facts established by experience. Belladonna, according to this view, both excites the sympathetic nerve and depresses the cerebro-spinal influence, wherefore its application to the breast diminishes both

[1] Revue Médicale, 1826, i. 17; ii. 384. [2] Journ. des Progrès, xiv. 254.
[3] Hecker's Preuss. medic. Zeit., Aug. 1834, p. 143.
[4] Lancet, Aug. 1856, p. 175. [5] N. A. Med. and Surg. Journ, i. 462.
[6] Ranking's Abstract (Am. ed.), xxv. 176.
[7] Bost. Journ., Aug. 1858, p. 23. [8] Ibid., Sept. 1858, p. 114.
[9] Ranking's Abstract (Am. ed.), xxvii. 179.
[10] Braithwaite's Retrospect (Am. ed.), xxxviii. 220.
[11] Berry, Lancet, June, 1857, p. 592.
[12] Kingsford, Lancet, Sept. 1858, p. 266.
[13] Bost. Med. and Surg. Journ., Aug. 1858, p. 80.

its secreting power and the supply of the material on which that power is exercised.

Sweating.—It is remarkable that a medicine whose tendency is to render the skin dry should not sooner have been used to control profuse sweating. Dr. Sydney Ringer[1] has adduced several examples of unilateral and of local sweating, in which the application of belladonna ointment effectually controlled the secretion; others in which the internal administration of the tincture had a like effect; and still others which were controlled by the hypodermic injection of atropia. In one case of unilateral sweating the hypodermic use of morphia increased the discharge, while one-hundredth of a grain of atropia, similarly used, checked the sweating in about a minute. Several other experiments confirmed absolutely the last-named result, even when the perspiration was artificially produced by means of the hot-air bath.

Fevers and Inflammations.—Dr. Harley claims for belladonna peculiar and beneficent virtues in febrile affections. He is of opinion that in appropriate doses ($\frac{1}{100}$ to $\frac{1}{60}$ gr. of atropia), its stimulant action is then converted into a tonic and sedative influence—much, we suppose, as alcohol exerts a similar influence by counteracting the disorder which is a direct effect of debility. We are assured by Dr. H. that in *pneumonia* the medicine hastens resolution, and that in *typhus* and *typhoid fever* it produces the best results. In the last edition of Dr. Murchison's work on Fevers (1873), little attention is given to the claims of belladonna except in the cases already referred to, and which Graves long ago described as appropriate for its exhibition—cases of typhus particularly, in which there is evidence of pulmonary engorgement; in which the pupil is persistently contracted; when the urine has become very scanty, or contains blood, or much albumen; and when the patient, although sleepless, is in a typhoid condition, and quite unconscious. This very partial concurrence in the conclusions of Dr. Harley is the only one of any authority which we have fallen in with, and we therefore conclude that the promised results have failed to occur in the hands of other physicians. For our own part, we have never felt inclined to admit the virtues of this or any other remedy which, when fully investigated, are found to consist merely in the power of palliating an external phenomenon which bears no uniform or essential relation to the elements upon which the tendencies and issue of the disease depend.

Nephritis.—"If," says Dr. Harley, "belladonna really influences congested bloodvessels in the way above indicated (*i. e.*, 'as a direct and powerful stimulant to the sympathetic nervous system') in any tissue of the body indifferently, it is to be expected that its power in relieving inflammatory conditions of the gland, which is solely instrumental in eliminating medicinal doses, will be even more rapid and decided." Several cases are cited by Dr. H. which appear to furnish a clinical corroboration of this view by their cure

[1] Practitioner, ix. 93.

effected under a treatment by belladonna. But Dr. T. Grainger Stuart, writing two years later of this alleged virtue in the medicine, only says, "I have, as yet, no experience of its effects."[1] Nor have we been able to discover any evidence tending to substantiate the original statement, which, if correct, is unquestionably of extreme importance. On the contrary, we have the evidence of at least one case, related by Dr. H. C. Wood,[2] showing that, in chronic tubal nephritis, belladonna may slightly diminish, instead of increasing the urine.

As a Prophylactic against Scarlatina.—When Hahnemann, about the year 1800, was engaged in observing the effects of medicinal agents, he noticed that belladonna produced a papular cutaneous eruption and dryness of the throat. These symptoms he imagined to be a sort of artificial scarlatina, and at once, pressing the fact into the service of his new theory, decided that belladonna was the natural specific for curing, as well as preventing, scarlet fever. Thus early, too, he betrayed his unfitness for a liberal profession by vending the medicine as a secret remedy.[3] This alleged power of belladonna has done more, perhaps, than anything else to sustain the impudent heresy of homœopathy, and for that reason practitioners have refrained from testing its truth. To do so is, however, both impolitic and unjust; for the allegation is not in itself repugnant to belief, and, if really true, is too important to be slighted.

In estimating the power of any agent to prevent a given event, it is necessary first to know the probabilities of that event taking place independently of all interference. We know that nearly all unprotected persons exposed to smallpox will contract the disease; hence the protective power of vaccination may be inferred with an approach to accuracy. In the case of scarlatina, on the other hand, the degree of contagiousness is not ascertained, for we constantly see families in which one or two persons only, out of perhaps eight or ten, are attacked. So uncertain is it, indeed, that many of the highest authorities deny altogether that scarlet fever is contagious. In any given instance, therefore, if belladonna were administered to all the members of a family of which one already had the disease, it would be impossible to say, if the disease did not extend, whether its arrest were owing to the exhibition of the medicine or not. But, it is no less certain, if this substance were given to many families or portions of families, during an epidemic of scarlatina, and, as a general rule, those who had taken it escaped the infection, while a large proportion of those who had not taken it were attacked, it is certain, we say, that the protective power of belladonna against scarlatina would be unequivocally proven, although the exact degree of that power might not be determined. And such, in reality, we believe to be the result of a fair induction from all the facts which have been recorded concerning this question.

Up to 1830 nearly all the published evidence had been collected

[1] Bright's Dis., 2d ed., p. 114. [2] Philad. Med. Times, i. 150.
[3] Jos. Frank, Pathol. Méd. (Paris, 1838), ii. 128.

by Bayle,[1] who states the following results: Leaving out of the account those authors who have omitted to mention the number of their patients, it appears that, in the midst of scarlatinous epidemics of greater or less severity, 2027 children and adults made use of belladonna, of whom 1948 escaped the disease, and 79 contracted it. These experiments were, in general, performed by competent persons, and the accuracy of their results cannot fairly be questioned. It may, however, be objected that the results are, after all, of a negative value, although derived from extensive observation, and that Lehmann and one or two others, after trying belladonna faithfully in epidemics of scarlet fever, concluded unfavorably to its protective power. The paucity of the cases of some objectors, and the meagreness of the details furnished by others, deprive their opposition of real weight; and, moreover, the circumstances under which some of the experiments above alluded to were performed render it obligatory to accept their results as true, or to believe, what is more improbable, their untruth. Thus, Dusterberg, at the commencement of an epidemic of scarlatina at Warburg, in 1820, administered belladonna to all the children under his care, but, for the purpose of determining how far the influence of the medicine was real, he withheld it from one child in each family. Every one of the latter was attacked, while but few of the former, and who had taken the belladonna during four or five days only, experienced the disease.[2] This instance appears to be conclusive, for its authenticity has not been denied.

Of later experimenters upon the subject under consideration, there are two whose observations were made upon an extensive scale. In the winter of 1840–41, M. Stievenart tested the question in several of the villages around Valenciennes, where scarlatina had already broken out. In one of the villages two hundred out of two hundred and fifty persons took the belladonna, and escaped the fever, while fourteen of the remaining fifty were attacked, and four died. In another village the medicine was administered to nearly all the pupils of the public schools; these, without exception, escaped, while several, who would not take the belladonna, were attacked.[3]

During an epidemic of scarlatina in Buncombe County, South Carolina, Drs. Ewing and Hardy kept an account of two hundred and fifty children who were placed under the influence of belladonna, and of that number less than half a dozen had the disease, and they but mildly. Those families which did not take the preparation were, with scarcely an exception, affected.[4]

An epidemic of scarlatina occurred at the Charleston (S. C.) Orphan House, in 1838. There were 114 inmates of the asylum, and the arrest of the epidemic among them is ascribed to the persevering administration of belladonna.[5] Dr. J. C. Morris admin-

[1] Bib. de Thér., ii. 503. [2] Rev. Méd., 1824, ii. 371.
[3] Bull. de l'Acad. de Méd., viii. 567.
[4] Southern Journ. of Med. and Pharmacy, Jan. 1846, p. 41.
[5] Charleston Med. Journ., vi. 476.

istered the medicine to one-half of the children at the Preston Retreat, Philadelphia, and found that 53 per cent. of these were attacked, while 73 per cent. of the remaining half had the disease.[1]

On the other hand, when experiments like the above were tried at Heriot's Hospital, Edinburgh, by Dr. Andrew Wood,[2] and at the Orphans' Asylum, Boston, by Dr. Alley, it was found, to use the words of the latter, that "there was no manifest difference between the two classes as to susceptibility to the contagion."[3]

If, now, we turn to the authorities who have not published the details of their experiments so much as the conclusions which they drew from them, and from the collective materials pointed out in the preceding paragraph, we shall still find the prophylactic virtues of belladonna affirmed by the most eminent physicians, particularly by Hufeland in Germany, and Guersant in France; the latter of whom states that he never failed to employ the method we are discussing, and that he had remarked the almost certain immunity of those who were subjected to it.[4] The dissentients from this view include, it is true, several eminent persons,[5] but, with the exceptions already stated, they do not, in general, appear to have formed an opinion deduced from any enlarged personal experience, but rather to have based their objections on the results of inadequate trials, or upon a very natural distrust of the original source of the statement that belladonna is a prophylactic against scarlatina. Thus Joseph Frank, in the work above quoted, expressly declares that he had not experimented with belladonna, because the use of Hahnemann's ridiculous infinitesimal doses is repugnant to common sense, and because he was conscientiously opposed to making a doubtful experiment upon healthy children with a medicinal dose of one of the most active poisons. It is enough, in refutation of such arguments, to say that the numerous successful trials which have been referred to, were made, not with the phantom doses of homœopathy, but with such as, although minute, were sufficient in a great many instances to produce an eruption on the skin and dryness of the throat, and yet without, in a solitary case, giving rise to unpleasant symptoms.

On a review of the whole subject, we feel bound to express the conviction that the virtues of belladonna as a protection against scarlatina are so far proven, that it becomes the duty of practitioners to invoke their aid whenever the disease breaks out in a locality where there are persons liable to the contagion, particularly in boarding-schools, orphans' asylums, and similar institutions, and among the families of the poor; whenever, in a word, it is difficult to place the healthy at a distance from the sick. The dose which it is proper to prescribe under such circumstances may be thus

[1] Am. Journ. of Med. Sci., April, 1857, p. 334.
[2] Boston Med. and Surg. Journ., Feb. 1857, p. 413.
[3] Ibid., April, 1857, p. 241. [4] Bull. de l'Acad., viii. 573.
[5] See BEGBIE, Br. and For. Med.-Chir. Rev., Jan. 1855, p. 101; BALFOUR, Month. Journ., vii. 426; Ibid., xi. 529. TROUSSEAU confesses that he is in doubt upon the subject.

stated. Dissolve from one to three grains of fresh and well-prepared extract of belladonna in an ounce of cinnamon water, adding a few drops of alcohol to prevent fermentation. Of this solution may be given, two or three times a day, one drop for each year of the child's age, to be so administered for two weeks, or longer, if the danger should continue. It is not pretended that the protection, such as it is, is permanent. On each recurrence of an epidemic the same process must be repeated.

Poisoning by Calabar Bean.—Dr. Thomas R. Fraser[1] has illustrated the antidotal action of atropia in poisoning by physostigma by numerous well-contrived and conclusive experiments on rabbits and dogs. Having first determined approximately the minimum lethal dose of physostigma for these animals of different weights, this dose, or one considerably greater, was administered after, along with, or previous to, a certain dose of sulphate of atropia. These experiments demonstrated, in the most rigid manner, that atropia counteracts or prevents the lethal action of physostigma, even by doses which are far below the minimum fatal doses of that alkaloid. The general result of the inquiry was also to show that physostigma increases the excitability of the vagi nerves, while atropia diminishes and suspends this excitability; that physostigma diminishes the arterial pressure while atropia increases it; that physostigma greatly augments the secretion of the salivary, bronchial, intestinal, and lachrymal glands, while atropia diminishes, and even completely checks these secretions; and that physostigma contracts the pupil, while atropia to a much greater relative extent dilates it. According to Dr. Fraser, in treating cases of poisoning in man by physostigma, the sulphate of atropia should be given by subcutaneous injection, in doses of from $\frac{1}{50}$ to $\frac{1}{30}$ of a grain, and repeated until the pupils are fully dilated, and the pulse rate increased, and probably, also, until the hypersecretion of bronchial mucus is checked.

As poisoning by physostigma is very unusual, and poisoning by belladonna or by atropia is very common, it would be interesting to know whether the antagonistic powers of these agents would be equally well displayed, when the poison originally taken is belladonna, or atropia, and when physostigma is employed as an antidote.

Poisoning by Opium.—The antagonism between opium and belladonna, to which, of late years, attention has been much attracted, is extremely interesting as an illustration of important physiological principles, and as one among the many instances which prove the degree of safety with which medicinal weapons may be wielded when their scope and force can be accurately determined. Doubtless the reciprocal antidotal power of these two agents would long ago have been recognized, and adopted among the precepts of therapeutics, had not a very natural timidity restrained their use to such small doses as to defeat the object aimed at in administer-

[1] Practitioner, iv. 65, 1870; Trans. Royal Soc. Edinb., vol. xxvi., 1872.

ing them. But it is now well understood that whenever a medicine cures by direct antagonism, its dose can have no limit but that of the active resistance of the morbific agent. Until this is neutralized the remedy is little apt of itself to become aggressive and dangerous. From the most ancient times stimulants, and especially wine, were used as antidotes to all the poisons of the class to which belladonna belongs. But perhaps we must come down to the seventeenth century to find a distinct recognition of the virtues of opium in poisoning by belladonna.[1] "Prosper Alpinus and Lobelius," says Giacomini, "had observed that when opium is associated with belladonna the action of the latter is diminished; Bonetus treated poisoning by belladonna with alexipharmics and stimulants; Camerarius had recourse to the same agents; stimulants and theriaca were prescribed by Faber, wine by Schenck; bezoars, aromatics, and volatile oils by Valentine; and Lippi effected several cures with Sydenham's laudanum." These citations of the eminent Italian physician were made, in part, it may be remarked, to justify his classification of medicines, in which opium ranks as a stimulant and belladonna as a sedative agent. Treating of the former, he remarks: "Opium has uniformly been found useful in poisoning by sedatives, as by belladonna, stramonium, and hyoscyamus." This was the theme of an inaugural dissertation by J. Lipp, in 1810, which was afterwards published by Autenrieth, and in which it was advised to use, "after evacuation of the stomach and bowels, small and frequently repeated doses of opium, as one or two drops of laudanum every five minutes, with camphor and wine, to counteract the drowsiness, etc."[2] In 1838, Dr. Graves published a paper "on the state of the pupil in typhus, and the use of belladonna in certain cases of fever,"[3] from which it appears that Dr. Corrigan suggested the possible utility of narcotics which dilate the pupil in those cases of fever in which this opening is inordinately contracted. Accordingly Dr. Graves associated belladonna with opium in the treatment of this symptom, and after trial concluded it to be "a most useful addition to the remedies usually employed in fever;" stated that "it evidently had saved the life," of one private patient, and that in the Hospital, "draughts consisting of black drop, belladonna, and tartar emetic, had been eminently serviceable." The commentary of this eminent clinician is so characteristically full of good sense and scientific spirit as to deserve reproduction: "It may appear extraordinary to think of prescribing for a single symptom, and giving belladonna in a case of fever with contraction of the pupil, merely because it produces dilatation of the pupil; but it is not . . . . . *unphysiological to conclude, that if a remedy be capable of counteracting or preventing one very remarkable effect of a certain morbid state of the brain, it may also counteract other symptoms connected with the same condition.*" In 1843 Angelo Poma made use

[1] Bodæus, Commentary on Theophrastus, p. 1079.
[2] Richter, Ausf. Arzn., ii. 563.
[3] Dublin Journ. of Med. Sci., xiii. p. 351.

of laudanum as an antidote to poisoning by belladonna. Probably without being acquainted with these facts, Dr. Anderson, of Edinburgh, starting from the idea that because belladonna dilates the pupil, it might also counteract those diseases in which contraction of the pupil is a prominent symptom, administered the medicine in several cases of poisoning by opium. Its effects appeared to answer the expectations of the experimenter.[1] In a case of poisoning by laudanum which had reached an alarming stage, and after five hours had elapsed from the swallowing of the poison, Dr. Mussey, of Cincinnati, administered first the extract and afterwards the tincture of belladonna, until, in the course of five or six hours, seven grains of the former and an ounce of the latter preparation had been given. Recovery took place; but, except that the patient complained for a few hours of being unable to see distinctly, none of the peculiar effects of belladonna were manifested.[2] Two cases were reported by Mr. Bell, of Edinburgh, in which, when alarming symptoms followed the subcutaneous inoculation of atropia, they were rapidly subdued by the use of morphia applied in the same manner.[3] Ten cases of poisoning by belladonna berries, and which all occurred at the same time, are reported by Mr. Seaton;[4] they were all treated by laudanum internally, and but one, that of a scrofulous and feeble woman, terminated fatally. A remarkable tolerance of opium was shown in every case. The supervention of sleep was an indication of a favorable issue, and when the patients awoke the pupils were either contracted or reduced to their natural size.

After these, numerous other cases were published, which left the fact no longer open to doubt that opium and belladonna are mutually antagonistic, and in the strictest sense antidotes to each other. A table containing the greater number of those reported at the time of its publication is given by Dr. W. F. Norris.[5] It comprises nine cases of poisoning by opium and eighteen of poisoning by belladonna. If the antidotes were occasionally unsuccessful, it seems to have been only when they were too grudgingly administered. Since the second edition of this work a large number of cases have been published demonstrating the antidotal action of opium or morphia in poisoning by belladonna, and of belladonna or atropia in poisoning by opium and its preparations.[6]

Drs. Mitchell, Keen, and Morehouse performed a large number of experiments to test the mutual relations of atropia and morphia

[1] Month. Journ. of Med. Sci., April, 1854, p. 377.
[2] Bost. Med. and Surg. Journ., Feb. 1856, p. 56.
[3] Edinb. Med. Journ., July, 1858, p. 6.
[4] Times and Gaz., Dec. 1859, p. 551.
[5] Am. Journ. of Med. Sci., Oct. 1862, p. 395.
[6] The following will be found of interest: *Morphia against poisoning by belladonna*, Annuaire de Thérap., xxxviii. 38; Bull. de Thérap., lxviii. 181; lxix. 236; Times and Gaz., Oct. 1864, p. 385; Trans. New York State Med. Soc., Nov. 1865, p. 159; Am. Journ. of Med. Sci., April, 1866, p. 434. *Belladonna against poisoning by opium*, Archives Gén., 6ème sér., v. 203; Bull. de Thérap., lxix. 277; ib., lxx. 138, 495; New York Med. Journ., Nov. 1866, p. 116; Dublin Quart. Journ., Aug. 1865, p. 221.

administered by subcutaneous injection. Substantially, their conclusions were as follows: 1. Atropia does not lessen pain, but morphia does so, and all the more efficiently the nearer to the seat of pain it is injected, at least in cases of neuralgia. 2. Morphia does not lower the pulse, but atropia, after rendering it less frequent, accelerates it notably. 3. Morphia does not counteract the action of atropia upon the pulse. 4. The two agents are mutually antagonistic in their action upon the iris, but that of atropia endures the longest. 5. "The cerebral symptoms caused by either drug are, to a great extent, capable of being overcome by the other, but owing to the different rates at which they move to affect the system, it is not easy to obtain a perfect balance of effects, and this is made the more difficult from the fact already mentioned, that atropia has the greater duration of toxic activity." 6. Morphia does not prevent the dryness of the mouth caused by atropia; nor does atropia prevent the nausea caused by morphia. 7. Atropia relaxes, morphia constipates the bowels. 8. Dysury is caused by both, and when so produced is not relieved by either. 9. Atropia does not alter or lessen the anodyne effects of morphia in neuralgia. 10. In their toxical effects upon the cerebral organs they are antidotal; but this antagonism does not prevail throughout the whole range of their influence.[1]

The experiments of Erlenmeyer[2] singularly confirm the results which have just been given, in every point but one; it has been seen that among these results was this, that the subcutaneous injection of atropia has no power to lessen pain, but the more recent experimenter merely says that when one of the two alkaloids fails in this effect, the two conjoined will succeed. Although the latter statement is not very explicit in adjudging anæsthetic powers to atropia, the possession of them by this substance would seem to be too well settled, by the evidence furnished elsewhere of its power to cure neuralgia, to be overturned even by the experiments which seem to imply that conclusion.

Bricheteau, after analyzing all the cases relating to the subject, which had been published down to 1866, concludes: "By these facts the antagonism of opium and belladonna is chemically demonstrated. In a case of opium poisoning, if belladonna is given, the effects of the latter are not proportioned to its dose, nor are those of the opium aggravated, which could not fail to occur if both agents operated without being antidotal to each other; moreover, the patients recovered rapidly, notwithstanding the enormous doses of opium taken. The same statement is correct, *mutatis mutandis*, regarding belladonna poisoning treated by opium."[3]

The condition of the pupil is an infallible index for the exhibition of opium and of the mydriatics in poisoning by the one or the other of them. Until the contracted pupil begins to dilate, or the dilated pupil to contract, no danger from the antidotes need be

[1] Am. Journ. of Med. Sci., July, 1865, p. 67.
[2] Archives Gén., Mars, 1866, p. 360. [3] Bull. de Thérap., lxx. 539.

apprehended. Their antagonism is complete. But it by no means follows that the dilatation in the one case, or the contraction in the other, is an index of the patient's safety; it merely proves that the antidote is active. This antagonism permits us to explain the cases in which the two medicines have been taken together, and in excessive doses, without occasioning any alarming consequences, and, in some instances, even without producing any effects at all. It may be added that Dr. Percy,[1] in his Prize Essay on Atropia, concludes from a review of the published cases, that there is, upon the whole, abundant evidence to prove that opium and belladonna, morphia and atropia, are mutally antidotal. It is unnecessary to attempt to indicate the precise dose of either medicine which should be administered as an antidote. That will depend altogether upon the gravity of the symptoms. The facts which have now been brought together are very interesting, and harmonize with what was elsewhere stated respecting the antagonistic action of opium and sulphate of atropia, the former producing a dilatation, and the latter a contraction of the capillary vessels of the web of a frog's foot.

The use of belladonna has been suggested in *delirium tremens* when the pupil is greatly contracted, but as yet there is no proof of its efficacy.[2]

[1] New York Med. Journ., viii. 269.

[2] It would not be proper to close this notice of the alleged antagonism of belladonna and opium without reference to the conclusions arrived at by Dr. Harley, from his experiments, of which the following is a summary (op. cit. p. 300): A.—*As to the influence of atropia on the action of opium.* 1. Atropia increases the cerebral and anæsthetic effects of opium. 2. Excepting in those parts of the body where we recognize two sets of involuntary contractile fibres . . . atropia has no influence in diminishing the cramping and convulsant effects of opium, but, on the contrary, slightly increases them. 3. By virtue of a more powerful stimulant action on the sympathetic nervous system than on the spinal, atropia in sufficient doses *is able to counteract and overcome the cramping influence of opium on the occluding contractile fibres.* 4. The influence of belladonna in removing the respiratory difficulty is slight and ineffectual, since it extends only to *the release of the bronchial tubes*, without affecting the diaphragm or internal respiratory muscles. 5. *By removing the restraint due to partial collapse of the lungs, atropia thus indirectly relieves the distended heart; while the direct and powerful stimulant action of the drug on the heart itself greatly facilitates and completes the result.* (The italics are not in the original.) B.—*As to the influence of opium on the action of belladonna.* 6. Except where the spinal and sympathetic nerves meet in muscular antagonism, the actions of opium and belladonna are concurrent, each intensifying the other. 7. The antagonism between them is purely local, and dependent on a stimulant action common to both, but in an unequal degree. 8. In man, a full medicinal dose of belladonna is required to neutralize the spinal effects of a full medicinal dose of opium on the pupil, the lungs, and the stomach. 9. It is impossible to neutralize the *local effects* of the action of belladonna or opium without increasing the *general action* on the rest of the cerebro-spinal and sympathetic nervous systems twofold.

From these propositions, which epitomize the extended and careful experiments of Dr. Harley, we think that it is not difficult to infer a possible antagonism between opium and belladonna sufficient to render the one medicine clinically an antidote to the poisonous effects of the other. The passages that we have underlined seem to imply so much, if nothing more.

But Dr. Harley, it has been seen, does not regard such an inference as correct, and he further defends his thesis by adducing clinical evidence which, it must be admitted, has considerable force; for he shows that in numerous instances of

Administration and Doses.—Belladonna may be administered in substance, infusion, extract, and tincture. One grain of the

opium-poisoning patients have recovered, without any active treatment whatever, from narcotism occasioned by unquestionably poisonous doses of that drug. He adduces several other cases to demonstrate that when belladonna was used as an antidote, it either exerted no demonstrable influence or positively aggravated the cerebral symptoms, and that it is powerless to obviate the chief danger in opium-poisoning, viz., the depression of the respiratory function. Yet he recommends employing "the subcutaneous injection of $\frac{1}{96}$ of a grain of sulphate of atropia at intervals of two hours, when the heart shows indications of a failing power." If in opium-poisoning death sometimes results from the failure of the heart, as it certainly does, and if atropia prevents that failure from reaching a fatal degree, then, surely, in so far, atropia is a counter-poison or antidote to opium, and science justifies what experience has established.

The following is a summary of cases illustrative of the subject which have been published since the last edition of this work:—

1. A young woman took laudanum equivalent to twelve grains of opium, and vomited a portion; was narcotized, but not profoundly. Ten drops of tincture of belladonna were given and repeated. The symptoms rapidly declined. (Blondeau, Bull. de Thérap., lxviii. 135.) 2. A young woman attempted suicide by laudanum; was in profound coma, with faint pulse and cold skin. Tincture of belladonna, ten drops at a time, until seventy were given. The pupils began to dilate, and narcotism subsided. (Ibid.) 3. Atropia-poisoning fully developed; repeated small doses of laudanum, followed by a decline of the symptoms, and cure. (Peleghem, ibid., lxxx. 331.) 4. Belladonna-poisoning; laudanum in small and repeated doses; cure. (Sinio, ibid., lxxvi. 126.) 5. Belladonna-poisoning; laudanum in frequent and small doses; cure. (Peleghem; ibid., lxxxi. 94.) 6. One and a half grains of atropia; laudanum in doses of from 80 to 20 drops—in all, 200 drops; cure. (Agnew, Penna. Hosp. Rep., i. 357.) 7. Child of $3\frac{1}{2}$ years took one grain of atropia in three drachms of water; subcutaneous injection of $\frac{1}{8}$ grain of morphia; "very soon" the pulse fell from 160 to 120, and in forty-five minutes consciousness and speech returned. (Horing, Am. Journ. of Med. Sci., Jan. 1869, p. 275.) 8. Hypodermic injection of one-fourth of a grain of morphia; profound coma; respirations four per minute; hypodermic injection of one-quarter of a grain of atropia; pupils immediately dilated; stertor ceased; respiration rapid; cure. (Wilson, Philad. Med. and Surg. Reporter, Nov. 17, 1868.) 9. One ounce of laudanum; profound narcotism; at hourly intervals eleven injections of $\frac{1}{30}$ gr. of atropia, and one of $\frac{1}{60}$ gr.; cure. (Carter, Philad. Med. Times, i. 277.) 10. One ounce of laudanum; coma *not* profound; thirteen hypodermic injections of $\frac{1}{60}$ gr. of atropia; one every half hour; recovery. (Bucklin, New York Med. Journ., xiv. 400.) 11. Narcotism and collapse from opium; atropia $\frac{1}{60}$ gr.; three injections at half-hour intervals; pupils dilated; recovery. (Ibid.) 12. A feeble man took $1\frac{3}{4}$ gr. of sulphate of morphia, and $1\frac{1}{4}$ gr. opium in the course of $7\frac{1}{2}$ hours; complete narcotism; thirteen injections of atropia at hourly intervals, amounting to half grain of atropia; opiate narcotism, followed by belladonna delirium, and death in collapse. (Brooks, Philad. Med. Times, iii. 708.) 13. A young woman had taken an ounce and a half of laudanum to destroy her life, and fell into complete coma; had no inspiration unless excited by the "postural method;" the pulse was extinct, and the heart fluttered feebly: $\frac{1}{48}$ of a grain of atropia hypodermically; in a short time a natural respiratory act and a distinct pulse; pupils soon dilated. In twenty minutes, the previous condition threatening to return, the injection was repeated with a like mitigation of the symptoms; another relapse was arrested in a similar manner. The reporter, Dr. Schell, subjoins this pertinent commentary, which is, indeed, the key of the whole matter: "It would seem that there is no advantage in pushing the atropia until the pupils are widely dilated, but that it is sufficient to give enough to stimulate the nervous centres, whence the pneumogastric springs to the degree of action necessary to keep the heart and lungs in motion until the system can rid itself of the poison." (Philad. Med. Times, iv. 134.) This is essentially the same conclusion which Dr. Harley drew from his experiments, and which has been quoted above. A review of the cases of which a brief summary has been given shows that when the antidote appeared to be successful, it was administered in this manner. 14. In this case, the only fatal one from atropia-poisoning which we have met with during the

powder of the roots or leaves, and one-quarter of a grain of either extract, are the average doses which it is safe to begin with. They may be gradually increased until the pupil becomes affected. The fluid extract of belladonna root contains one grain of the root in sixteen minims: Dose, three to five minims. An infusion, made with twenty grains of the leaves to half a pint of water, may be given in doses of half a fluidounce every four or five hours. Of the tincture, the dose is fifteen or twenty drops for an adult. Atropia and sulphate of atropia may be given in the dose of from one-fiftieth to one-twentieth of a grain, but with great caution, since even the one-hundredth of a grain is capable of producing characteristic symptoms in susceptible persons. "For *subcutaneous use*, a solution of one grain of sulphate of atropia in a fluidounce of water is most suitable, as there is less liability of using too much than with a stronger solution; and the medium dose, ♏v to ♏viij, is a convenient quantity." (*Harley.*) One or two drops of this solution may be used to dilate the pupil by instillation at the external angle of the lids, or by introducing between them at that point a small slip of fine blotting-paper saturated with the solution. An *ointment* of atropia may be made by incorporating one grain of the alkaloid with a drachm of fresh lard, after solution in alcohol or in glycerin.

STRAMONII FOLIUM.—Stramonium Leaf.

STRAMONII SEMEN.—Stramonium Seed.

Description.—*Datura Stramonium* is a plant which abounds in Europe and the United States, as well as in Eastern countries, grow-

period above indicated, a middle-aged, healthy woman took, by mistake, three grains of atropia. Sopor began to appear in an hour, and in three hours from the time of swallowing the poison a grain and a half of morphia was hypodermically administered, followed in less than half an hour by half a grain, and a few minutes later another half grain of morphia. Thus, two and a half grains of morphia were injected in the space of an hour. (S. W. Gross, Am. Journ. of Med. Sci., Oct. 1869, p. 401.) It is evident that this method of administering the antidote differs entirely from that which proved successful in the cases already cited, and which, in connection with Dr. Schell's case, we have ventured to pronounce the only efficient one. In the instance last detailed, the patient died fifteen hours after taking the poison, presenting every appearance of stasis of the venous blood in the skin and internal organs, including the brain and spinal marrow, which were also softened. The lungs were congested, and the bronchia filled with mucus; the heart was very much softened, and its cavities contained fluid blood. These are not lesions distinctively characteristic of belladonna-poisoning.

The following cases, which, by an oversight, were not included in the analysis presented above, may be referred to by those who desire still further to investigate the subject: Brit. and For. Med.-Chir. Rev., Oct. 1868, p. 551; New York Med. Journ., viii. 367; Bull. and Mém. de la Soc. de Thér., i. xx.; Boston Med. and Surg. Journ., Dec. 1868, p. 273; Lancet, May, 1869, p. 637; Annuaire de Thér., xxix. 27, 30; Trans. Penna. Med. Soc., 1869, p. 486; Practitioner, iv. 27; v. 27; Times and Gaz., May, 1870, p. 564; N. York Med. Record, vi. 343; Am. Journ. of Med. Sci., April, 1871, p. 373; Ibid., Jan. 1872, p. 283; Ibid, April, 1873, p. 337; Ibid., July, 1873, p. 279; Bull. de Thérap., lxxviii. 38, 93; lxxx. 230, 320, 331.

ing luxuriantly wherever the soil is rank, but especially near the habitations of men. In this country it is familiarly known as *Jamestown weed*, a name which it derived from the circumstance that a party of soldiers, at Jamestown, Va., were poisoned by the leaves of the plant which they boiled and ate as greens.[1] It is an annual plant, of the natural family Solanaceæ, three feet high or more, with smooth, shining stems and spreading branches, and large leaves of an elongated triangular form, and sinuous edges; they are of a dark green color above, but paler below. The flower is large, funnel-shaped, pentangular, of a pale color, and is succeeded by a green capsule of the size and form of an English walnut, covered with prickles, and containing numerous dark kidney-shaped seeds. The root is thick, fibrous, and white. The whole plant exhales a rank narcotic odor. The leaves and seeds are officinal.

The active properties of this plant depend upon *daturia*, an alkaloid principle which was discovered by Geiger and Hesse in stramonium seeds, the part in which it is most abundant. It forms clusters of brilliant colorless prismatic crystals, is inodorous when pure, but in its impure state has a repulsive smell, and a bitter acrid taste resembling that of tobacco. According to Planta's analysis, its composition is identical with that of atropia.

The following preparations of stramonium are officinal:—

Extractum Stramonii Foliorum.—*Extract of Stramonium Leaves.*

This extract is obtained in the usual manner by exhausting powdered stramonium leaves with alcohol, and evaporating the tincture to a proper consistence. *Dose*, a grain.

Extractum Stramonii Seminis.—*Extract of Stramonium Seed.*

It is obtained essentially in the same manner as the preceding extract, but from powdered stramonium seed. *Dose*, a quarter of a grain.

Tinctura Stramonii.—*Tincture of Stramonium.*

It is made by percolation of diluted alcohol through four troy-ounces of powdered stramonium seeds, so as to obtain two pints of tincture. The average dose is fifteen minims.

Unguentum Stramonii.—*Ointment of Stramonium.*

Sixty grains of the extract of stramonium softened with water, rubbed with an ounce of lard, form this ointment. It is used as a local anodyne and discutient application.

Medical History.—It is uncertain whether or not the powers of stramonium were known to the ancients, but there can be no doubt that for a knowledge of its remedial virtues we are indebted to Störck, of Vienna, who made various experiments with an extract prepared from the fresh plant, and published an account of them in 1762. Since that period stramonium has held a prominent position in the materia medica, and been the subject of repeated

[1] Beverley's Hist. of Virginia, 1722, 2d ed., p. 121.

examinations, of which some of the earliest were prosecuted in this country.

Action. *On Animals.*—Various animals eat stramonium with impunity. Insects of the caterpillar tribe feed upon it, and goats devour it without injury. A decoction of the leaves applied to the skin of a young rat produced alternate debility and convulsive movements.[1] Very large doses administered to the horse have induced drowsiness, gaping, and even death.

On Man.—The symptoms to which stramonium may give rise so closely resemble those already ascribed to belladonna, that no detailed analysis of them need be presented. It will be sufficient to point out the principal groups of phenomena which are occasioned by its administration. According to Dr. Cooper, two grain doses of the powdered leaves slightly increase the fulness and frequency of the pulse, and produce a warm skin, moisture of the hands and face, and a little giddiness; while five grain doses cause decided intoxication, dilatation of the pupil, difficulty of speech, nausea, thirst, dryness of the throat, relaxation of the bowels, and increased flow of urine, and some feverishness. In larger, and what may be considered poisonous doses, the first effect is to excite immoderately. The whole aspect of the patient is that of a person with high fever and delirium; he may seem happy, talking nonsense and laughing, or be violent, biting and striking furiously; the movements are irregular and sometimes much resemble the contortions of chorea, or those of an intoxicated person, and complaint is apt to be made of dizziness, with heaviness or lightness of the head, and a disposition to faint; the face is flushed, occasionally swollen, the eye bright, the conjunctiva injected, the pupil dilated, and the sight confused, and the skin is sometimes profusely covered with a bright red eruption which may be followed by a crop of minute vesicles,[2] or the eruption may resemble erysipelas, at first, and measles at a later period.[3]

The mental excitement and disorder occasioned by an overdose of stramonium may be very aptly illustrated by the case of the soldiers at Jamestown, which was alluded to above. Beverley informs us that "some of them ate plentifully of the plant, the effect of which was a very pleasant comedy; for they turned natural fools upon it for several days. One would blow up a feather in the air, another would dart straws at it with much fury; and another, stark naked, was sitting up in a corner, like a monkey, grinning and making mouths at them; a fourth would fondly kiss and paw his companions, and sneer in their faces, with a countenance more antic than in any Dutch droll. In this frantic condition they were confined, lest they should in their folly destroy themselves; though it was observed that all their actions were full of

[1] Cooper, Caldwell's Theses, pp. 170, 174.
[2] De Witt, Med. Repository, ii. 28.
[3] Dr. R. E. Griffith, Am. Journ. of Med. Sci., v. 252; Faust, Charleston Med. Journ. and Rev., ix. 746; Calkins, Boston Med. and Surg. Journ., June, 1856, p. 398.

innocence and good nature. . . . . After eleven days they returned to themselves again, not remembering anything that had passed." In another case the patient seemed plunged in a reverie which was interrupted by sudden shrieks, or by convulsions; and in others still, the delirium was so furious as to call for forcible restraint. Meanwhile the head was hot, the pupils largely dilated, the face bloated and red, and the hands and feet cold and tremulous.

In Dr. De Witt's case, referred to above, there was manifested a strong aversion to fluids. When a cup of water was brought to the patient's lips she would instantly start from it, and relapse into a convulsive paroxysm. Lobstein observed a similar phenomenon in two instances. At a later stage, in fatal cases, or in such as tend to become so, excitement, hallucinations, and spasmodic movements are succeeded by stupor, insensibility, and relaxation, or even paralysis; the pupil is fixed and inordinately dilated, the pulse rapid and thready, and the skin hot and perspiring. Among the anomalous symptoms of poisoning by stramonium is one observed in the case of a man to whom all black objects appeared to be green.[1] At no period in the progress of the symptoms, until death seems imminent, is there the least tendency to sleep; on the contrary, there is obstinate insomia, and yet, on the recovery of the patient, he retains no distinct recollection of what has occurred.

These peculiar qualities of stramonium have rendered it a convenient agent for the speculations of knavery, for there is reason to believe that much of the phantasmagoria of sorcery was derived from this source, and that the oblivious intoxication of stramonium has been employed to facilitate and conceal the perpetration of crime. The latter is attributed to the Hindoos, but seems to have had Christian imitators. For, as Trousseau and Pidoux relate, a band of thieves was brought to trial, whose plan of procedure was this: They mixed the powder of stramonium seeds with snuff, and, in places of public resort, were very assiduous in offering the snuff-box to such of their neighbors as they wished to rob. As soon as the victims began to be confused, and talk at random, they were pillaged without difficulty.

In the preceding account it is not easy to discover any essential difference between the action of belladonna and of stramonium; their effects upon the nervous system are nearly identical, and it is only in the fact that stramonium appears to augment the several excretions of the body more than belladonna, that a distinction between the two can be perceived.

The same approach to identity exists between the effects of daturia and atropia. Indeed the Drs. Husemann, in their work on the active principles of plants, treat of them under a common title. According to Schroff, the former is of about twice the strength of the latter. Wertheim arrived at the same conclusions. It is singular, however, as Reil remarks,[2] that their strength should be

[1] Husemann, Journ f. Pharmakodynamik, ii. 191.
[2] Mat. Med. der reinen chemischen Pflanzenstoffe, Berlin, 1857.

so unequal while they are identical in composition. According to Charpentier daturia dilates the pupils more rapidly than atropia, but the effect is less prolonged, and is never followed by contraction of the pupil. A quantity in solution exceeding four milligrammes (one-sixteenth of a grain), cannot be instilled into the eye without causing redness and pain. By the stomach a larger dose than one-tenth of a grain is unsafe, but its toxical phenomena are less intense and lasting than those of atropia. A congested state of the skin may exist, but not the scarlatinoid eruption. Headache is more severe, with neuralgic paroxysms; the pulsations of the heart and arteries are quickened; there is an uneasy feeling about the præcordia, with a sense of faintness; restless and noisy delirium occurs with hallucinations; erection also and seminal pollution; but no disorder of the bowels.[1]

In regard to the operation of this alkaloid, Hoppe concludes from numerous and minute experiments that it expends its power mainly upon the nerves of motion, and especially those of the bloodvessels, while it influences the sensory nerves in an inferior degree. He also intimates that its primary stimulant impression is followed by a state of debility or exhaustion of the nerves, and that the cerebral phenomena which it occasions are due chiefly to vascular congestion of the brain.[2]

According to Oulmont and Laurent[3] the operation of *daturia* is almost identical with that of *hyoscyamia*. The following are their conclusions from numerous experiments upon the action of these alkaloids. 1. They act especially upon the sympathetic nerve. 2. In small doses they contract but in large doses dilate (paralyze) the capillaries. 3. Arterial tension is increased by small and diminished by large doses. 4. As the pulse grows more frequent it also becomes smaller. 5. Hyoscyamia regulates but daturia interrupts the heart's movements. Locally applied both alkaloids arrest the heart's action. 6. They always quicken the respiration. 7. In moderate doses they do not affect sensibility or motility; by large doses cutaneous sensibility is blunted. 8. They do not affect the excitability of striated muscles. 9. In small doses they quicken, in large they paralyze, the movements of the intestine. 10. The general phenomena they occasion are due to their influence on the circulation. They are brief, for the alkaloids are rapidly eliminated with the urine. 11. Their dilating action on the pupil is excited through the sympathetic nerve. 12. Small doses slightly raise the animal temperature, large ones lessen the central heat.

Remedial Employment.—The similarity of stramonium and belladonna in their poisonous action doubtless led to the employment of the former in diseases which the latter had been found adapted to relieve. It was, at all events, in affections of the nervous system that Störck first prescribed stramonium, and founded our knowledge of its curative powers.

[1] Annuaire de Thér., xxiv. 21.
[2] Die Nervenwirkungen der Heilmittel, 2tes Heft, S. 146.
[3] Archives de Physiol. etc., 1870, p. 341.

Insanity.—Störck reports the cure of two cases of insanity, both of which were of long standing, and one of them complicated with an organic disease, hydatids of the brain. De Durande, Bergius, Greding, Schneider, and Bernard have also published examples of occasional success.[1] Amelung regarded stramonium as a valuable remedy in acute mania, *mania cum febre*, after depletion, and other antiphlogistic measures had been duly employed. He also held it to be useful in shortening the paroxysms of periodical insanity, and in tempering the violence of the more permanent forms.[2] The late Professor Barton attributed to this agent the recovery of an insane patient, and Dr. Eberle declares that in a case of hysterical mania it afforded unequivocal relief.[3] On examining, however, such of the cases recorded by these writers as appear to have been favorably influenced by stramonium, the greater number are found to be examples of puerperal insanity, the form of mental derangement which, of all others, has the strongest tendency to recovery, when removed from hostile influences. Yet stramonium, like other narcoties, may very probably accelerate its cure. Dr. Chapman was of opinion that this medicine would be found more efficacious in melancholia than in any other form of mental derangement. A former superintendent of the Massachusetts Lunatic Hospital, Dr. Woodward, whose field of observation was so extensive, and so thoroughly scanned by him, expresses his opinion of the virtues of stramonium in the following words: "In some cases its effects are very favorable, in others it not only disappoints our hopes, but sometimes actually coincides with diseased impressions, and aggravates the symptoms. In cases of insanity connected with epilepsy . . . I have seen excellent effects from this remedy . . . the symptoms of both are often greatly diminished in force and frequency."[4]

Some years since, M. Moreau, one of the physicians of Bicêtre, made numerous experiments with stramonium in the treatment of insane hallucinations; being led to do so by the resemblance which this morbid state bears to that produced by the narcotic in question. In several instances the trial met with complete success; but only when the hallucinations were primitive, that is to say, when they commenced with the attack, and formed its prominent characteristic. The remedy was administered in the form of an extract of the purified juice, in doses gradually increased from half a grain to eight grains, and sometimes until dilatation of the pupil, vertigo, and coldness of the extremities, gave notice of commencing intoxication.[5] M. Brierre de Boismont, in his excellent treatise upon hallucinations, states that other physicians have not been equally fortunate with M. Moreau in the employment of stramonium, at the same time admitting that such a condition as the drug is capable of inducing must be well adapted to break in upon and dispel the imaginary torments of the patient.[6]

[1] Bayle, Bib. de Thérap., tom. ii. p. 269.
[2] Journal des Progrès, tom. xvii. p. 84.
[3] Therapeutics, p. 369.
[4] Annual Report, etc., 1845.
[5] Gaz. des Hôpitaux, Oct. 1842.
[6] Des Hallucinations, etc. (Paris, 1845), p. 508.

Much earlier than the experiments of Moreau, Dr. King, of Suffield, Connecticut, reported two cases which he regarded as meningitis, and the cure of which was evidently due to stramonium.[1] In one, that of a lad about fourteen years of age, there was delirium *with phantasms*, on the third day; on the fifth, convulsive twitchings, coldness of the hands and feet, and largely dilated pupils. At this stage a decoction was made with half a drachm of stramonium seeds in four ounces of water, boiled down one-half, and a teaspoonful of it administered every half hour. The following night the patient slept about fifty minutes, and his delirium was less violent. The medicine was continued in more frequent doses, and on the seventh day from the invasion of the disease, the fever and delirium had much abated, and urine was copiously discharged. On the eighth day, the patient was calm and composed, after a quiet night's rest, and so recovered. Dr. King does not assign a motive for the treatment adopted by him in this case, but it was doubtless the same which guided Moreau in the method which he pursued under somewhat analogous circumstances.

Epilepsy.—The evidence in favor of stramonium as a remedy for epilepsy is, perhaps, quite as slender as for that of any other in the long catalogue of specifics for this intractable malady. A certain number of cures have doubtless followed its administration, and some of them were in all probability produced by it. Thus, in the summary furnished by Bayle, it appears that out of forty-five cases reported by various authors, *thirteen* were cured, and as many more relieved by the treatment in question. Of the latter number a portion experienced less frequent and less violent attacks, others became subject to slight fainting fits instead of the convulsive paroxysm, and others, again, at the usual periods of the attacks, suffered from an extremely annoying formication.[2] In the United States, Dr. Archer, of Maryland, celebrated the virtues of stramonium in epilepsy more than half a century ago,[3] and pointed out, more distinctly than others have done, the class of cases in which it is most efficacious. These are, according to his experience, when the fits occur at short intervals, and periodically, and, therefore, afford time for bringing the patient under the narcotic influence before the commencement of another paroxysm. When the intervals were of irregular length, Dr. Archer found that the treatment was less successful. It is possible that a want of regularity and attention in administering the medicine may account for its failure in epilepsy, when used by other physicians; for, in the observance or neglect of these elements of treatment, lies the secret of a thousand conflicting reports of the virtues of remedial agents. Of other American authorities the only one, besides Dr. Archer, who appears to have brought the treatment we are discussing to a sufficient test, is Dr. Woodward, and he, in the report already cited, ascribes to it very decided curative powers. "In many cases," he remarks,

[1] Med. Repository, vol. ii. (1805), p. 32. [2] Bib. de Thérap., vol. ii. p. 325.
[3] Cooper, in Caldwell's Theses.

"in which the paroxysms of epilepsy have recurred frequently, they have, for months, been wholly suspended by the use of the tincture of stramonium. . . . . This remedy rarely makes any favorable impression unless it is used in sufficient doses to dilate the pupils of the eye slightly, and produces some difficulty of vision more or less of the time."

Spasmodic Asthma.—The utility of stramonium in this affection is vouched for by a larger number of authoritative witnesses than testify in favor of its virtues in any other malady. In most of the diseases hitherto noticed the medicine was employed experimentally, and on the suggestion of analogy; but in the one before us, it appears to have been popularly and successfully resorted to before it fell under the notice of physicians. In the East, the roots of another species of datura, *D. ferox*, are regarded as a specific for paroxysms of asthma. They are cut into slips as soon as gathered, air-dried, and then beaten into fibres resembling those of hemp. These shreds are smoked in a pipe, with or without tobacco, according to the habits of the patient. A knowledge of this circumstance was communicated by the English General, Dent, on his return from India, in 1802, to Dr. Sims, by whom the employment of the medicine was encouraged. Dr. Sigmond[1] informs us that a war of pamphlets and journals, in which the remedy was by turns eulogized and stigmatized, took place upon its introduction into general use. Some of the parties to this conflict were dishonest and mercenary, and their unworthy motives, as well as their abusive publications, seem to have excited in the minds of many honorable practitioners a deep-rooted prejudice against stramonium itself. Thus Dr. Bree, who had been personally attacked, published an extremely unfavorable account of his experience with the medicine, attributing to it a greater or less degree of injury in twenty-four out of eighty cases, and declaring that the remainder had received no permanent benefit. Much of the testimony of English writers of this date is evidently tainted by undue partiality or prejudice, and must be corrected by that of more impartial observers, which, as will be seen, corroborates the statements of those who first employed the drug in Europe as a remedy for asthma.

The cases of Krimer,[2] five in number, were all well-marked examples of spasmodic asthma, and in all of them the relief obtained from smoking stramonium was not only prompt and complete, but permanent. Much more recently (1836), Miquel published a number of instances of the value of this treatment drawn from his own observation, and from the practice of Biett, Martin-Solon, Andral, and Cayol. Among them were several in which the dyspnœa seems to have been produced by pulmonary emphysema, and others in which there was a copious bronchial secretion; nevertheless, in all of them considerable relief was obtained.[3] Chanel,[4] Mirande,[5] and

[1] Lancet, 1836–37, vol. ii. p. 393.
[2] Bayle, op. cit.
[3] Bull. de Thér., tom. xi. p. 13.
[4] Ibid., p. 326.
[5] Ibid., tom. xiii. p. 157.

Legal[1] likewise reported a few cases confirmatory of Miquel's results, and more recently (1846), Dr. Namias, an Italian physician, recalled the attention of the medical profession to the importance of the treatment we are discussing.[2] One of the cases related by him may serve to illustrate the subject. A bookseller was subject to severe attacks of asthma in the spring season, which were generally mitigated by assafœtida, emetics, and sinapisms. In the spring of 1845, the paroxysms were unusually violent, the pulse corded and irregular, the face livid, the respiration laborious and carried on by the voluntary muscles. The patient was forced to sit up in bed, and every moment seemed about to suffocate. A pint of blood drawn from the arm, and a dose of ipecacuanha, afforded no relief; nor did revulsives, nor even a renewal of the depletion, act more favorably. At this stage stramonium smoking was prescribed. The relief was almost miraculous; in less than a quarter of an hour the breathing became free, and the patient complained only of fatigue. Next day, the cough, which had been dry, became humid, and a regular attack of catarrh succeeded, but without the least oppression of the respiration.

Trousseau and Pidoux[3] are not in any degree behind the authors already cited in their favorable opinion of stramonium in asthma. They are careful, however, to apply this term only to paroxysmal dyspnœa independent of structural lesions of the lungs, heart, or great vessels. In this form of the disease, they have seen stramonium effect a complete cure. Still, if it frequently succeeds, it often also fails, even in paroxysmal asthma, while it sometimes promptly mitigates the more permanent forms of the affection. The effect of stramonium fumes on simple spasmodic asthma is marvellous during the first few months or years of its use; but, if the attacks are severe and frequent, the medicine by degrees loses its power over the disease. It may also be prescribed as a palliative of dyspnœa and cough in consumption, chronic catarrh, and organic diseases of the heart, whenever the violence of these symptoms appears to proceed from nervous disorder.

In this country stramonium is very generally employed to palliate asthma, but little or nothing has been written, beyond the expression of opinion, from which the degree of its utility can be inferred. A partial exception to this statement is that of Dr. Bigelow, who informs us that "it would not be difficult to designate a dozen individuals in Boston and its vicinity who are in the habit of employing it, with unfailing relief, in the paroxysms of the distressing complaint." Eberle, Chapman, and Dr. Wood all testify to the occasional efficacy of the treatment, but appear to think that it more frequently fails than succeeds. It may be fairly concluded that the contradictory opinions expressed by different authors arise from the fact that those practitioners who have reported the most uniform success have been careful to ascertain the purely spasmodic

[1] These de Paris, 1835, and Arch. Gén., 2ème série, tom. xi. p. 498.
[2] Arch. Générales, tom. xvi. p. 97. [3] Op. cit.

character of the cases in which they administered the remedy, while most of those who esteem it lightly have prescribed it in many cases of dyspnœa arising wholly, or in greatest part, from organic disease. Here, as in other instances, correct diagnosis is the only substantial basis of rational treatment.

Much of the hostility against the use of stramonium in asthma, formerly displayed by the practitioners of Great Britain, may be attributed to the alarming and even fatal symptoms which occasionally followed this use of the drug, and particularly to the death of the officer who was the means of transplanting the oriental practice to England.[1] This event, however, was not justly attributed to smoking stramonium; for the patient recovered from the comatose state into which his unadvised and excessive employment of the remedy had thrown him, and, on the recurrence of a fit of dyspnœa, expired suddenly, probably from disease of the heart. It is, nevertheless, of the first importance that the remedy should be cautiously employed, and its use confined to those cases in which the nervous element of dyspnœa is the sole, or at least the principal, cause of suffering. All congestion or inflammation of the lungs or brain, and every structural disorder of the apparatus of circulation or respiration which gives rise to permanent shortness of breath, should be held as a paramount contra-indication; and, under no circumstances, ought the narcotic influence to be allowed to extend beyond creating a slight degree of vertigo. When the plethoric condition of the patient is the only obstacle to the employment of stramonium fumes, it may be removed by venesection or purgation.

About 20 grains of dried stramonium leaves, or half that quantity of the fibres of the root, may be smoked at once. Some persons direct them to be mixed with sage leaves, or with tobacco if the patient is accustomed to it. They may be smoked in a pipe or cigarette. Another method is to steep cigars in a strong decoction of stramonium; when dry, they are ready for use. The desired effect is much more promptly attained by drawing the smoke into the lungs, than by the ordinary mode of receiving it into the mouth alone.

In *whooping-cough* stramonium has been prescribed in the same way as belladonna, and for the same purpose; but there is much less evidence of its efficacy. In like manner it has been employed for the relief of *dysmenorrhœa.* Thus, according to Eberle, by exhibiting from twenty to thirty drops of the officinal tincture three times daily, for two or three days immediately preceding the period of the menses, the distressing pains attending this affection will, in some instances, be entirely prevented. In one case it effected a perfect cure.[2] Dr. A. T. Thomson found half-grain doses of the extract extremely useful in the same affection, in combination with Plummer's pill and digitalis.[3]

Retention of urine depending upon inflammation or tenderness

[1] Sigmond's Lectures, loc. cit.
[2] Therapeutics, p. 371.
[3] Elem. of Materia Medica, etc., p. 430.

about the neck of the bladder may sometimes be overcome without catheterism, by cataplasms of the bruised leaves of stramonium, or by the extract of this article applied in any manner with moist heat.[1] The anodyne and relaxing qualities of the combined application no doubt unite in producing the effect.

Neuralgia.—Stramonium, like belladonna, has been repeatedly applied to the treatment of the different forms of neuralgia, but with inferior success. Although in some instances it has proved equally efficacious, its influence, on the whole, appears to be less decided and certain. The experience of Lentin, Marcet, Begbie, and Kirchhoff, as reported by Bayle,[2] is quite unfavorable to the virtues of stramonium in facial neuralgia, but very favorable to them, on the contrary, in sciatica. Yet, according to Wendelstadt, of Hersfeld, stramonium is as truly a specific for facial neuralgia as quinine for intermittent fever.[3] The paper before us furnishes no details of his cases, and their value must remain conjectural. His mode of insuring the alleged degree of his success was to prescribe half a grain of the extract, which dose was repeated in an hour, and again in two hours more; on the following day, unless the state of the patient forbade it, a fourth dose was given. As soon as symptoms of narcotism appeared, the daily quantity was restricted to two doses, which was to be increased again on the subsidence of these symptoms, and the medicine continued until the due results were obtained. There is, doubtless, in this methodical and reiterated prescription of a medicine a greater power than could be inferred from its more casual effects. Other practitioners, and with them several of those cited, prefer the external application of stramonium, in tincture, extract, or substance, as a remedy for neuralgia; and, although it certainly acts as a palliative when thus employed, and in this country is to be preferred to belladonna (at least when the fresh thorn-apple plant can be procured), yet it certainly has not hitherto been supposed to possess equally valuable properties with the latter agent in the treatment of neuralgia.

Rheumatism.—Bruised stramonium leaves, either in their fresh state or stewed with lard, form a popular and very useful application to the joints, in chronic rheumatism, although perhaps not more so than any other emollient and anodyne cataplasm. The method is, however, a convenient one, and may, in some instances, answer a better purpose than more strictly pharmaceutical preparations. Liniments and ointments containing the tincture or extract of stramonium may be employed in frictions upon the affected part. One of the most intractable forms of chronic rheumatism is that in which Eberle found stramonium to be "the most efficacious remedy we possess," a form "attended by an irritable, quick, but weak pulse, swelled joints, and unattended with any great pain, unless on being moved."[4]

[1] Dr. W. Fahnestock, in Am. Journ. of Med. Sci., vol. v. p. 251.
[2] Bib. de Thérap., tom. ii. p. 280. [3] Bull. de Thérap., tom. xii. p. 239.
[4] Mat. Med. and Therapeutics, loc. cit.

Although principally employed in the chronic variety of rheumatism, stramonium has also been applied to the treatment of the acute articular form, by MM. Lebreton and Trousseau. The former prescribed the medicine in precisely the same manner as that directed for neuralgia by Wendelstadt, above described, and so as to maintain for several days its decided narcotic influence. Trousseau vouches for the safety of this treatment, and declares that he has derived advantages from it which none other appeared capable of affording; particularly when pursued in conjunction with active purging.[1] Similar good effects have been obtained by Chomel.[2] There is no reason why, in external applications at least, stramonium and its preparations should not take the place of more expensive and often less pure narcotics, in the treatment of every kind of painful affection. So common and at the same time so powerful an agent deserves more attention from American physicians than it has hitherto received, and of which any published evidence is to be found.

Hæmorrhoids.—Among the local uses of stramonium none excels in imparting comfort so much as its employment in piles and other kindred affections of the rectum. An ointment composed of ointment of stramonium, ointment of galls, and cerate of subacetate of lead, in equal parts, is an almost infallible remedy for the intolerable itching and burning which piles, vermicular ascarides, etc., occasion; it forms also a very soothing application in fissures of the anus.

Treatment of Poisoning by Stramonium.—Opium is the proper antidote for poisoning by stramonium as it is for poisoning by belladonna. A case of singular interest, on account of the quantity of the antidote taken, has been reported by Dr. Anderson.[3] A Sepoy having been poisoned by datura, Dr. A. administered by the mouth one grain of muriate of morphia every hour. Eight grains were taken before any result could be perceived. After the eighth dose slight signs were visible of awakening consciousness, but the pupil still remained widely dilated. Subsequently, as the symptoms abated, the intervals between the doses were lengthened, but in the course of eighteen hours fifteen grains of muriate of morphia were taken. Dr. Maddin, in the case of a child four years of age poisoned by eating stramonium seeds, and still in the stage of active intoxication, effected a rapid improvement in the symptoms, and ultimately dissipated them completely, by enemata of laudanum.[4] Dr. Turner, also, treated two children in the same condition and from the same cause with repeated doses of laudanum, and they both recovered.[5] Dr. Stevens has reported a case in which recovery took place after the use of opium;[6] and Dr. D. B. Putnam states that he had treated "quite a number" of cases of stramonium-poisoning successfully by means of opium, before the antagonism of the latter

[1] Op. cit. [2] Szerlecki, Dict. de Thérap., tom. ii. p. 429.
[3] Ranking's Abstract, xxxiii. 276.
[4] Ibid. [5] Am. Journ. of Med. Sci., April, 1864, p. 552.
[6] Boston Med. and Surg. Journ., Aug. 1871, p. 81.

drug and the mydriatics had been spoken of, and guided merely by their opposite effects on the pupil.[1]

Administration.—The leaves, root, and seeds of stramonium may be given in powder. Of the two former the dose is about two grains, and of the last, one grain, to be repeated several times a day until the characteristic symptoms produced by the drug begin to manifest themselves. Of the officinal extract of the leaves one grain, of that of the seeds a quarter of a grain, and of the tincture fifteen minims, are the average doses. The tincture is one of the best forms of the medicine, and can be used for nearly every purpose to which the other preparations are adapted.

HUMULUS.—Hops.

Description.—Hops are the strobiles of *Humulus lupulus*, a native plant of both hemispheres, with a perennial fibrous root, annually producing long creeping stems which are trained upon poles or trees, to the height of six or seven yards. The strobiles or fruit are of conoidal shape, and are formed by numerous superposed semitransparent scales, of a pale yellowish-green color when fresh, but brownish-yellow when dried. They have a strong aromatic and narcotic odor, and a bitter and spicy taste. They are covered with minute yellowish granules, which have received the name of lupulin, and which contain a larger proportion of the active principles than any other portion of the plant.

Lupulin is procured by shaking upon a fine sieve the hop strobiles of the previous year. It is a delicate powder, of a golden-yellow color, somewhat harsh and tenacious, and both bitter and aromatic. Its reaction is neutral; it is nearly insoluble in ether, and slightly soluble in water, but is completely so in alcohol.[2] About one-tenth of the weight of the hops employed is thus obtained as lupulin, which by repeated washings and decantations is cleansed from the fine sand that is always mingled with it. After being carefully dried at a temperature of not more than 76° F., it may be kept unchanged for years in well-stopped bottles. The composition of lupulin is exceedingly complex. According to MM. Payen and Chevallier, it contains[3]—1st, an essential oil, which is acrid, of a greenish-yellow color, and strong smell; it is capable of being spontaneously converted into resin, and is procured most abundantly from the lupulin of fresh hops; 2d, a bitter substance, of a yellowish-white color, which, even in a very small dose, produces a loss of appetite and suspension of the digestive function for eight or ten hours, and, according to other observers, dulness of the head, a sense of weariness, and heaviness of the limbs; 3d, a resinous substance, in the form of yellowish scales, soluble in alcohol, ether, and the alkalies, bitter, and imparting its bitterness to

[1] Bost. Med. and Surg. Journ., Oct. 1871, p. 240.
[2] Strumpf, op. cit.
[3] Dieu, Mat. Méd.

boiling water. The latter substance forms more than one-half of the lupulin, and its proportion is large when that of the essential oil is small.

The following preparations of hops are officinal:—

EXTRACTUM LUPULINÆ FLUIDUM.—*Fluid Extract of Lupulin.*

Sixteen troyounces of lupulin are used to procure, by percolation with stronger alcohol, first, twelve ounces of tincture, which is set aside until twenty fluidounces more of tincture are obtained. The latter is then evaporated to four fluidounces, and mixed with the reserved tincture. *Dose*, five to ten minims.

INFUSUM HUMULI.—*Infusion of Hops.*

It is prepared by macerating, for two hours, in a covered vessel, half a troyounce of hops in a pint of boiling water, and straining. *Dose*, two fluidounces.

TINCTURA LUPULINÆ.—*Tincture of Lupulin.*

This preparation is made by percolation with four troyounces of lupulin and enough alcohol to produce two pints of tincture. *Dose*, one fluidrachm.

Medical History.—Hop strobiles have long been held to possess medicinal virtues. By some writers an eastern origin is ascribed to the plant, which was, however, known in Europe during the midde ages, and was first described by Mesue in the ninth century. About the close of the sixteenth century, Arnold, of Villanova, recorded the use of hops to prevent the acetous fermentation of beer. In the seventeenth century we find their tonic properties recognized, as well as their tendency to cloud the mind and induce a sort of intoxication.[1] According to St. Hildegard, who lived in the twelfth century, hops are not of much use to man, since they increase the melancholic temperament, and render the disposition sad, and dry up his entrails; nevertheless they hinder fermented liquors from turning sour.[2] Matthiolus[3] ascribes to them numerous virtues, such as being an antidote to poisons; says that they are useful in gravel, syphilitic and other ulcers and eruptions, and that they are cholagogue, diuretic, emmenagogue, and anthelmintic. In 1803, Dr. Desroches, in his inaugural thesis, published at Edinburgh, attributed sedative and tranquillizing effects to the hop pillow and other preparations of the medicine; and, four years later, Mr. Freake, of London, claimed for it nearly all the virtues which any previous writer had alleged it to possess.[4] The suggestion of M. Planche, in 1813, that the yellow matter of the strobiles contains the medicinal virtues of the plant, was made practically useful by D. A. W. Ives, of New York, who published an essay in 1819, in which he gave to the substance the name of *lupulin.*

Modus Operandi.—As the active properties of hops depend almost exclusively upon the lupulin they contain, it will be unnecessary to consider these subjects separately. All writers agree

[1] STRUMPF, op. cit.
[2] BECKMANN, Hist. of Invent., iv. 338.
[3] Commentaries sur Dioscoride, 1605.
[4] Edinb. Med. and Surg. Journ., 1807.

that hops possess *tonic* powers, but some—Dieu, for example—consider their power of strengthening the digestion, improving the appetite, and relieving the sense of wretchedness which dyspeptics suffer, as altogether indirect, and only shown as the result of the primary and sedative action of the remedy, which removes the subacute inflammatory condition on which the functional disturbance depends. The infrequency of inflammatory dyspepsia, and its intolerance of even milder substances than preparations of hops, sufficiently refute the statement of Dieu, which appears to be an inference from a medical hypothesis, rather than the result of direct observation. Persons of a sickly complexion and impaired strength, who have taken infusion of hops for several weeks, find that the skin acquires a more healthy hue, and all the functions are more vigorously performed. Lupulin appears to possess more distinctly tonic virtues. In doses of from twenty to twenty-five grains it produces a lively sense of warmth in the epigastrium, which extends afterwards to the whole abdomen. Constipation, with colicky pains, is apt to ensue, and the digestion and appetite seem to be invigorated. Experience proves that hops are appropriate where the simple vegetable bitters are useful, and that they are of peculiar utility when a state of nervous excitability is united with feeble digestion. This is attributed to their sedative quality. It is not apparent when the quantity given is small, but, according to Mathon, large doses of lupulin diminish the frequency of the pulse. There is more evidence, however, that it acts as a sedative by calming restlessness and by strengthening the system against external impressions; by abating, in other words, the susceptibility which is one of the most frequent causes of an excited circulation.

Most writers on the materia medica ascribe to hops *narcotic* properties, and cite in evidence the well-known fact that the air of warehouses in which large quantities of hops are stored cannot be long inhaled without producing sleep, which is even related to have been fatal. The hop pillow has also long been a popular remedy for sleeplessness; it was used with advantage in the insanity of George III. But, as Vogt justly remarks,[1] all fragrant plants have a tendency to bring on sleep; the narcotic virtues of hops ought not, therefore, to be inferred from their possessing a similar property. The question can be settled only by noticing the effects of the internal administration of the medicine. Almost all the authorities are agreed that preparations of hops promote sleep, and some, as before remarked, ascribe to them distinctly narcotic qualities. The latter, however, draw their opinion from the action of the remedy in affections attended with pain and nervous agitation, forgetting that sleep naturally follows the removal of causes which prevent it, and in this sense alone do the former admit the existence of a soporific property in hops. In none of the experiments made on persons in health, or free from pain, have hops distinctly shown narcotic properties. Barbier[2] states that lupulin,

[1] Pharmakodynamik, i. 584. [2] Op. cit., p. 420.

in small doses, has no influence upon the nervous system; but in doses of twenty-four grains, for example, it acts with energy, producing a painful sense of numbness in the limbs, heaviness, and weariness, but neither headache, dulness of mind, nor giddiness, and, above all, no tendency to sleep. Experiments tried by the same author with a decoction of hops gave rise to none of the indications of nervous sedation just enumerated, a fact which may fairly be attributed to the evaporation, by boiling, of the essential oil contained in the strobiles. This explanation is also deducible from the experiments of Desroches, which, as early as 1803, pointed to an essential oil as the so-called narcotic element of hops, a conclusion which the later experiments of Payen and Chevallier confirmed.

Remedial Employment.—The multifarious virtues which have been ascribed to hops would seem to fit them for a great variety of medicinal uses, but in practice they are chiefly resorted to where a gentle *tonic* and sedative effect is sought to be produced. In *atonic dyspepsia* they have been found to be very serviceable, either alone or as an adjuvant to other medicines of greater power. Dr. Ives assures us that "diseases which are the consequence of exhausted excitability, or more directly of a deranged state of the stomach and bowels, are certainly much relieved by this medicine. It frequently induces sleep and quiets great nervous irritation without causing costiveness or impairing the tone of the stomach."[1] At a still earlier period, Freake attributed to this medicine very decided powers in relieving nervous languor and debility, and, above all, gout, both regular and atonic.[2] It should be taken immediately before meals whenever its tonic properties are chiefly invoked; and in this case lupulin is preferable to the infusion of hops, as being less bulky, and exerting a more powerful, because a more concentrated, action.

Hops have been extensively used in a great variety of diseases in which *tonics* and *alteratives* are supposed to be indicated; in those, namely, which take their root in a lymphatic constitution, and which offer the proper symptoms of *scrofula* and its associated diseases, such as *rachitis*, glandular enlargements, some forms of dropsy, anæmia, amenorrhœa, chronic cutaneous eruptions, etc. Before the discovery of iodine, hops were an almost universal remedy, or adjuvant, at least, in this class of maladies, and were much esteemed for their presumed depurative power. Anæmic children, with puffy cheeks, tumid belly, and a general languor of the mental and bodily functions, were found to recover activity, strength, and color under their use, and the skin, if defaced by eruptions, assumed a natural color and texture. Although the preparations of iodine, and more recently cod-liver oil, have almost entirely supplanted other remedies for scrofula and its attendant diseases, it will be found advantageous to combine in their treatment the use of hops with that of

[1] Ives' edition of Paris' Pharmacologia, 1825.
[2] On the Humulus Lupulus of Linnæus. London, 1806.

the more powerful agents, by directing hop-tea to be used by the patients as a common drink.

The so-called *sedative* virtues of hops are nowhere more conspicuously shown than in the treatment of *delirium tremens*. In a large proportion of cases of this affection there is a total loss of appetite, and very frequently the stomach can neither retain nor digest food. With the exception of those few instances in which the organ is in a state akin to inflammation, as shown by epigastric pain and heat, with bilious vomiting, this weakness of the digestive function is speedily removed by a liberal use of hop-tea—of, for instance, two or three quarts in the twenty-four hours. The first draught or two may be rejected, but the vomiting affords relief, and before many hours have elapsed there is a manifest abatement of the nervous agitation, and the indifference to food is lessened. Exercise in the open air contributes largely to these favorable results. Refreshing sleep is procured by the means recommended more readily than by any of the other expedients employed for the purpose in delirium tremens, but not, as it seems, by the narcotic virtues of the medicine so much as by its power of calming agitation. In these and other cases of sleeplessness from over-excitement or want of "tone" of the nervous system the hop pillow is deserving of trial. A remedy employed in so unusual a form would of itself be apt to make a favorable impression.

Dr. W. B. Page, of Philadelphia, was the first to draw attention to the value of lupulin as a remedy for painful priapism in venereal cases, and for involuntary seminal emissions. Dr. E. Hartshorne knew it "to destroy the veneral appetite in a man addicted to onanism."[1] The experience of Dr. Page has been confirmed by that of numerous physicians. In France it was thought useful by Débout in various cases of morbid erection of the penis, including those in which this condition was produced by contusion, by gonorrhœa, and by the operation for phimosis.[2] Zambaco found the tincture of hops more efficacious than lupulin.[3] Pescheck notices the tonic property of the latter as a valuable adjuvant of its more specific operation in spermatorrhœa.[4] Herzfelder proved its advantages in cases of nocturnal incontinence of urine,[5] and Dr. G. B. Wood in a case of irritable bladder in which opium was not tolerated.[6]

Hops have been a good deal employed as an *antiperiodic*, and numerous evidences might be cited of their efficacy in slight cases of intermittent fever. But the same might be said of almost every medicine containing a bitter principle. As an *external* application, in the form of a poultice made with water in which hops have been infused, or a fomentation formed by saturating the strobiles with hot water, spirit, vinegar, or beer, hops form a popular and most

[1] Am. Journ. of Med. Sci., July, 1849, p. 293.
[2] Bull. de Thérap., xxviii. 557; xliii. 325; xliv. 289, 385; xlviii. 128.
[3] Ibid., xlvii. 161.
[4] Brit. and For. Med.-Chir. Rev., July, 1856, p. 265.
Bull. de Thérap., lii. 187.
[5] Trans. of Coll. of Phys. of Phil., June, 1857.

useful application in a great variety of painful affections. For *muscular rheumatism*, *sprains*, *bruises*, *boils*, *toothache*, *flatulent colic*, and, in general, all painful affections without high inflammation, these applications are extremely useful palliatives. An *ointment* compounded with hops is said to have eased the violent pain in the last stage of cancer when all other applications were ineffectual;[1] but this needs confirmation.

Administration and Dose.—An eligible form of administering this medicine is the *infusion*. Of this the medium dose is f℥ij to f℥vj every two or three hours. Lupulin may be given in the pilular form, or mixed with a little jelly or syrup, in the dose of from six to twelve grains. The tincture of hops, and the fluid extract may be substituted for the other forms of this medicine where the alcoholic menstruum is not contraindicated. A pure and strongly hopped beer contains all the virtues of the remedy in so high a degree, that, as Mitscherlich remarks,[2] there are but few cases in which any other preparation of it is necessary. But ordinary malt liquors are too unscrupulously adulterated to deserve this praise.

DULCAMARA.—Bittersweet.

Description.—Solanum dulcamara, bittersweet, or woody nightshade, of the natural family *Solanaceæ*, is a woody, climbing vine, indigenous to Europe, but naturalized in the United States. It grows in hedges and on the skirts of woods, where the soil is fertile and shaded. Its stem and leaves are slightly pubescent; the latter are of a dark-green color, petiolate, lanceolate at their further extremity, and auriculate at their base. The flowers are in branched racemes opposite the leaves, of a violet color, but sometimes white, and are succeeded by small oval berries of a brilliant scarlet color. Both the roots and berries of the plant are operative, but in medicine the young branches only are officinal. They are most active if gathered in the autumn, when they are cut in pieces of two or three inches long and carefully dried, with the pith which they contain. In their fresh state the stalks exhale a rank and nauseous smell, and have the bittersweet taste described below. In the United States, dulcamara is found in the Eastern and Northern States, and most abundantly in damp and shady places; but that which grows in high and dry situations is said to be the best.

Decoctum Dulcamaræ.—*Decoction of Bittersweet.*

A troyounce of bittersweet is boiled in a pint of water for fifteen minutes and strained; sufficient water is then added through the strainer to measure a pint. *Dose*, two to four fluidounces.

Extractum Dulcamaræ.—*Extract of Bittersweet.*

Twelve troyounces of powdered bittersweet are exhausted by percolation with alcohol; one-half of the alcohol of the resulting

[1] Freake, loc. cit. [2] Lehrbuch, etc., ii. 134.

tincture is distilled off, and the residue evaporated to a proper consistence. *Dose*, three to six grains.

EXTRACTUM DULCAMARÆ FLUIDUM.—*Fluid Extract of Bittersweet.* After obtaining by percolation three pints of tincture from sixteen ounces of bittersweet, the liquor is evaporated to a pint, and after ten troyounces of sugar have been added, it is again reduced by evaporation to a pint. *Dose*, a fluidrachm.

Dulcamarin is the name given to a substance obtained from this plant, and which was first isolated by Wittstein in 1852. It is a yellowish-white, transparent, resinous-looking substance, becoming whiter by pulverization, and in alcoholic solution shows a faintly alkaline reaction. Like the plant, its first and transient taste is bitter, but it leaves a more persistent sweetness on the palate. Dulcamara also contains the alkaloid *solania*, and most abundantly in the green substance of the stalks. It was discovered by Desfosses in 1821. To the naked eye, solania has the appearance of a fine white powder, but under the microscope is seen to be formed of acicular crystals and rhomboidal scales. It has neither taste nor smell, according to Clarus, but Schroff describes its taste as feebly cool, acid, and saline, and as irritating the throat. It is insoluble in cold water, but in hot water it is partially, and in hot alcohol and in glycerin completely soluble.

Medical History.—Dulcamara, like many other medicines, has by turns been neglected and extravagantly praised by writers on the materia medica; some have altogether passed it by, while others held it to be almost a specific in many diseases. The number and credit of the latter class are such as to enforce respect, in spite of the silence or even the contrary statements of other respectable authorities; it may therefore be profitable to learn what virtues have been ascribed to the medicine by those who employed it most extensively and with the greatest degree of success.

It is generally supposed that Dioscorides intends to describe the plant in question under the name of *Ampelos agria*, or *Vitis sylvestris*, which he affirms to be curative of dropsies. Its berries, according to him, are useful in softening the skin and removing pimples and freckles, and his commentator, Matthiolus, informs us that the Tuscan ladies employ them for this very purpose.[1] According to the same writer, Galen describes a precisely similar use of the plant. Fuchsius and Tragus, in the sixteenth century, were among the first to give it the name it now bears, for they noticed that the taste of the twigs was bitter on their first being chewed, but afterwards sweet.[2] Dulcamara was held in great esteem by Boerhaave, and its virtues were celebrated by his school. Linnæus, and, in France, Sauvages, were no less earnest in its praise, which was extended by Razoux, Carrère, De la Grésie, Starke, and others.[3]

[1] Commentaries, liv. iv. ch. 175.

[2] The *present* Latin name expresses an idea the very reverse of the fact, and has doubtless misled several authors in their description; *e. g.*, MÉRAT and DE LENS, Dict., etc., vi. 411.

[3] MURRAY, op. cit

It was indeed to be feared, as indeed it turned out, that like other objects of extravagant eulogy, this medicine might become undervalued or be entirely neglected. At the present time it is far less frequently employed than it used, and than its virtues entitle it, to be; for that these are considerable, there can be no reasonable doubt.

Action. *On Animals.*—It is reported by Floyer that thirty berries of the bittersweet killed a dog within three hours, but Dunal gave fifty berries to another dog without any effect.[1] Oesterlen, too, throws doubt upon the first of these statements, for he gave a dog two hundred berries, and a cock fifty, without any effect whatever.[2] These differences might, perhaps, according to Dr. Taylor,[3] be explained by supposing that the active properties of the plant vary in power at different seasons of the year, were it not that they exist, as has been seen, even in regard to the berries, which can be gathered only at one season. In experimenting with the watery extract, Dunal produced equally negative results as with the berries, for he administered no less than four ounces of this substance to dogs without any bad effect; and Oesterlen gave it in ounce doses to a patient, but caused no untoward symptom.[4] These results might perhaps be attributed to the bad quality of the preparation, for Bruschi produced symptoms of poisoning in animals by means of an extract made from the leaves.[5]

The fact that *solania*, an active poison, can be obtained from dulcamara, proves that the contradictory results mentioned above must have been due to accidental causes. According to Sobernheim, a single grain of this substance, made soluble in water by means of diluted sulphuric acid, killed a small rabbit in six, and a larger one in eight hours. About an hour after taking the poison the animals became incapable of moving their hinder feet forwards; the hind legs of the smaller ones were also quite stiff, and the toes stretched out; then followed great dejection, retching, and signs of pain. No evidences of inflammation were discovered on dissection; the veins were distended with blood. The condition of the hinder extremities is remarkable from its resemblance to that produced in horned cattle fed upon sprouting potatoes, which contain alcohol. An epidemic erysipelas among swine has been attributed to a like cause, but the experiments of Fraas show that these animals may take as much as half a drachm of solania, or of its salts, without noticeable effects.[6] Geiger found that solania did not produce dilatation of the pupil like the other alkaloids of the solanaceæ. When administered to a dog or cat in doses of from two to four grains, it brings on vomiting, and drowsiness, which lasts for several hours. Fraas states that in ten-grain doses it only excites vomiting and quickens the circulation in a dog. A cat took eight grains of this substance without loss of life; after vomiting vio-

[1] Murray, Mérat and De Lens, op. cit.
[2] Sobernheim, p. 56.
[3] On Poisons, 2d Am. ed., p. 670.
[4] Sobernheim, loc. cit.
[5] Giacomini, ed. cit., p. 301.
[6] Virchow's Archiv, vi. 225.

lently, it fell into a profound sleep, which lasted for thirty-six hours.[1] Otto, and also Fraas, found that rabbits were destroyed by doses of sulphate of solania varying from one to three grains. Clarus drew a like conclusion from his experiments, and also inferred from them that death in these cases is produced by a depressing influence upon the medulla oblongata, which induces serous congestion of the lungs. A similar congestion of the kidneys was observed, and the urine was found to be albuminous.[2] Caylus, of Leipsic, concluded from his experiments that solania exerts a depressing or paralyzing action upon the medulla oblongata, but acts as a stimulant to the nerves. According to him its poisonous operation consists in its paralyzing the nerves of respiration, as conia and nicotia do.[3]

On Man.—The accounts furnished by authors of the effects of dulcamara upon persons in health are extremely contradictory. The greater number assert that very large doses of the medicine must be taken to produce any sensible or marked effects, while others declare that it exhibits poisonous qualities in comparatively small doses. As an illustration of the latter class may be cited instances related by Hufeland, in which merely sleeping in a room where dulcamara was drying gave rise to symptoms of poisoning. They may have been, and probably were, due to the odor which the plant exhaled. Oesterlen denies that the medicine possesses any narcotic virtues; and unquestionably there is no adequate proof that it tends *directly* to induce sleep. Its influence upon other portions of the brain than the sentient and perceptive organs, as well as upon the circulatory apparatus and its dependencies, the glands, is much more demonstrable, as will appear in the sequel. It ought not, however, to be concealed that cases of narcotic poisoning are ascribed to this plant—such, for instance, as the following reported by M. Chailly:[4] A child, eighteen months old, swallowed a fresh flower of dulcamara, and immediately fell into a profound sleep, which lasted for eighteen hours, after which the infant was still disposed to stupor, and its pupils were dilated. These symptoms gradually disappeared in the course of the day. The case was related before the Medical Society of Paris, and doubts were expressed as to the reality of the alleged cause of the symptoms—doubts which it is not easy to avoid sharing. Children, attracted by the bright-red color of the berries of dulcamara, very frequently eat them; but, as Neumann remarks, it is very rare that any worse effect that vomiting is produced. Neumann states that delirium tremens is much more apt to follow the use of potato brandy than of other alcoholic drinks, and suggests that this fact may result from the liquor containing solania, derived from the skins of the potatoes in the process of manufacture.[5]

In moderate or medicinal doses the preparations of dulcamara

[1] Giacomini, ed. cit., p. 301.
[2] Journ. of Pharm., i. 245.
[3] Bull. de Thérap., lxi. 534.
[4] Rev. Méd. de Paris, 1835, ii. 291.
[5] Heilmittellhre, 2te Aufl., p. 222.

give rise to no definite symptoms, at least until the medicine has been used habitually and for a considerable period. But if large doses are taken from the beginning, nausea and vomiting pretty certainly ensue; there are dryness, heat, constriction, and stinging of the throat, thirst, and sometimes diarrhœa. Old and nervous persons are apt to have convulsive movements of the lips, eyelids, and hands, with tremulousness of the limbs, especially if the surface of the body is at the same time chilly. The head feels heavy and giddy, and occasionally some delirium has been noticed, but the latter symptom so rarely as to countenance the suggestion that it was produced by *solanum furiosum*, and not by the milder plant under consideration. A protracted use of the medicine is said to have caused paralysis of the tongue and dilatation of the pupils. Occasionally dulcamara gives rise to an erythematous eruption on the skin, a fact that should not be lost sight of in considering the efficacy of the medicine in cutaneous diseases. Dr. G. B. Wood observed in several instances, when the system was under its influence, a dark, purplish color of the face and hands, and at the same time considerable languor of the circulation.[1] Its influence upon the function of secretion is admitted by almost all the authorities. In moderate doses it is said to increase the activity of this function in the skin, kidneys, and lungs, but in making these statements enough consideration has not perhaps been given to the watery vehicle in which it is always administered; the increase of the renal secretion, at least, most probably depends upon the latter element. The alleged diaphoretic quality of the medicine is better established by direct observation, and is confirmed by the collateral evidence which proves its tendency to the skin.[2] Carrère and Starke both mention itching and heat in the female organs of generation, with painful strangury, and sometimes even venereal desires, as among the effects of the medicine. Should this statement be correct, as well as the one made by several physicians, that it has the power of *subduing* the sexual appetite of maniacs and others in whom this propensity is morbidly active,[3] both facts should be borne in mind as illustrating the opposite effects sometimes produced by medicines when administered in health and disease.

The operation of *solania* resembles in many points that which has just been described. Schroff administered this substance to healthy persons in various doses, from one-thirtieth of a grain to three grains, and observed increased cutaneous sensibility, itching of the skin, gaping, general numbness, sleepiness, slight tonic cramps in the legs, and increased frequency of the pulse, which at the same time grew feeble and thready; there was some dyspnœa and oppression in breathing, with nausea and unsuccessful efforts at vomiting; the head was hot, heavy, and dizzy, with drowsiness, yet with inability to sleep; the extremities were cold, the skin dry

[1] U. S. Dispensatory.
[2] Sobernheim, Giacomini, Murray, et al., op. sup. cit.
[3] Dr. G. B. Wood, U. S. Dispensatory.

and itching, and there was marked general debility. The pupil remained unchanged; the sleep was restless, and disturbed by frightful dreams.[1]

What has now been stated is sufficient to warrant the judgment of Vogel, who takes Joseph Frank to task for asserting that the preparations of dulcamara are inert. Its narcotic action may be, and probably, indeed, is weak and uncertain, but, however that may be, it must at any rate be regarded as a valuable agent for improving nutrition and secretion slowly and gradually, and bringing about the cure of numerous chronic affections which depend directly upon a feeble or vitiated state of these functions.

Remedial Employment.—Dulcamara has been chiefly employed in *eruptive*, *rheumatic*, and *catarrhal* affections, as an internal medicine. But it had previously been in more general use as an external application to cancerous and other *sores*, as well as inflamed or bruised parts, under the idea that it possessed narcotic virtues. Subsequently it was employed in decoction to bathe the skin irritated by *eruptions*, and it was for these affections that the medicine was first prescribed internally. Linnæus states that in Upland it is looked upon as a specific against scabies, and bears a name expressive of the belief.[2] Crichton claims to have cured twenty-one out of twenty-three cases of *lepra* by the use of the following decoction: ℞.—Dulcamaræ, ℥j; aquæ, Oiss; decoque ad Oj, et cola—of which he ordered two ounces every morning, noon, and night, increasing the quantity until a pint was consumed daily.[3] In like manner Gardner states that he met with almost constant success in using this remedy for *pustular* and *vesicular* as well as *scaly eruptions.* Even the most inveterate cases yielded to its influence, without any local application. But these results he ascribes to his thorough and persevering manner of exhibiting the medicine, which will be described below.[4] That others have reported much less favorably of its powers must in all probability be imputed to their defective manner of administering it.

Bretonneau[5] looked upon dulcamara as one of the most useful agents in the treatment of all the affections which have been mentioned, and of those internal diseases which arise simultaneously with the disappearance of cutaneous disorders, and which used to be attributed, perhaps not without reason, to the repercussion of a morbid humor. M. Rayer states that he has several times employed the decoction of dulcamara with success in lepra, but at the same time remarks that he has also carried the remedy so far as to produce dizziness without making a sensible change in the disease.[6] Clarus[7] goes further, and says that *lepra vulgaris*, *psoriasis*, *guttata*, and *pityriasis* are not benefited by this medicine. Yet he admits its utility in *chronic eczema*, *acne* and *impetigo* of the face, and *ecthyma vulgare*, particularly when they occur in persons of a scrofulous

[1] Pharmakologie, p. 552.
[2] Murray, loc. cit.
[3] Edinb. Med. and Surg. Journ., ii. 65.
[4] Lond. Med. and Phys. Journ., May, 1830.
[5] Trousseau and Pidoux, ii. 109.
[6] Mal. de la Peau, art. Lépre.
[7] Loc. cit.

constitution. Chapman confirms by his testimony the favorable statements that have been made, declaring that he has known it to remove chronic eruptions when even the better established remedies had totally failed.[1] These, and such other proofs which might be adduced, should suffice to dispel the incredulity which some authors have expressed in regard to dulcamara, and to restore it to a due degree of usefulness.

Dulcamara has been strongly recommended in *gout* and *rheumatism* and especially the muscular variety of the latter, by almost all the writers who have recorded its virtues, and with justice, it may readily be believed, when we regard the sedative, diaphoretic, and narcotic virtues of the plant, and the indications it can thereby fulfil in the diseases mentioned. Boerhaave, Hufeland, Linnæus, Bergius, and many minor authorities, assert it to be useful in these diseases, especially when they have assumed the chronic form, and when also they seem to be allied to a cachectic state of the general system in connection with syphilis or scrofula. It is, indeed, against the latter cachexia, which serves as the warp on which so many chronic diseases are woven, that dulcamara seems to be one of the most efficient agents, and well worthy of being prescribed in conjuction, or in alternation, with the numerous remedies which are also employed for its removal.

In many *diseases of the chest* dulcamara has enjoyed a wide reputation, which it chiefly owes, no doubt, to its sedative virtues, by means of which coughing is rendered less frequent and severe. Thus may be explained its reputed virtues in spasmodic coughs such as belong to emphysema and *whooping-cough*, and to certain cases of phthisis, which last it has even had the reputation of curing. In this manner also may we account for the fact that it is habitually employed by Italian practitioners in both acute and chronic inflammations of the lungs.[2] Chronic pulmonary catarrh and *bronchorrhœa* are reported by many authors to have been cured by this medicine, but its combination with other active agents renders the task of assigning to it a just share in the result impossible. It has been thought to be most evidently useful in those cases of pulmonary disease which follow directly upon the sudden disappearance of a cutaneous eruption.

Administration and Dose.—The extract, fluid extract, and decoction are officinal, but the first is of doubtful virtue and is seldom used. The officinal decoction can be depended on only when it is of a bright green color, and has the characteristic odor and taste of the fresh plant. It should always be well stirred before being taken. From one to two fluidounces should be administered three or four times a day, and the dose gradually increased until the characteristic effects of the medicine begin to appear. It may be mixed with milk to conceal its nauseous taste. Of the *fluid extract* the dose is from thirty minims to a fluidrachm, three or four times a day.

[1] Therapeutics, ii. 225. [2] GIACOMINI, op. cit.

CANNABIS INDICA.—East India Hemp.

CANNABIS AMERICANA.—American Hemp.

Description.—*Cannabis* is an annual plant of the natural order *Urticeæ*. The East Indian variety, *C. Indica*, is much larger and stronger than *C. sativa*, and reaches a height of twelve or fifteen feet. It has an erect, branching, angular stem, and deeply-incised palmate leaves, with acutely dentated edges. The male and female flowers are upon the same plant, and grow in axillary clusters. The fruit is ovate and one-seeded. The seeds yield oil abundantly. American hemp is *C. sativa*, cultivated in North America. The flowering tops are the officinal portion.

The medical properties of the plant reside in a resinous substance which exudes from glands upon the surface of the stalks and leaves, and which is also procured by boiling the flowering tops in alcohol and evaporating to the consistence of an extract. This substance, in its purest state, is of a dark olive-green color, soft and adhesive when warmed, has a fragrant narcotic odor, and a bitter and acrid taste. It is soluble in alcohol and ether, but not in water. The resin separated from the gum, albumen, lignin, etc., with which it is associated has received the name of *cannabin*. By prolonged distillation of water on large proportions of cannabis a volatile oil is extracted in minute quantities, which possesses an overpowering odor, and is held by some to be the constituent to which alone the resin of cannabis owes its peculiar properties.

Extractum Cannabis Indicæ.—*Extract of Indian Hemp.*

It is obtained by exhausing finely powdered Indian hemp with alcohol, and evaporating the product to the proper consistence.

Extractum Cannabis Americanæ.—*Extract of American Hemp.*

It is prepared in the same manner as the extract of Indian hemp. The primary dose of either extract should not exceed half a grain.

Tinctura Cannabis.—*Tincture of Hemp.*

This is a filtered solution of four hundred and eighty grains of extract of Indian hemp in two pints of alcohol. *Dose*, from five to twenty drops.

History.—The *nepenthes* of Homer was probably a preparation of hemp. Herodotus is reported by Hesychius as saying that the Scythians make use of hemp-seeds to dry up the semen,[1] and Pliny also states that this power is attributed to them.[2] These statements are abundantly confirmed by modern witnesses. Haschisch blunts the sexual propensity, and, in the long run, extinguishes it. Dioscorides recommends the seeds in the form of a cataplasm to soothe inflammation and discuss tumors.

The Chinese were acquainted with hemp as an anæsthetic as early as the third century of the Christian era. According to

[1] Theophrastus, ed. Bodæus, p. 945. [2] Hist. Nat., lib. xx. cap. xcvii.

Stanislas Julien, a celebrated Chinese physician named Hoa-Thoa (A. D. 220) operated on his patients after having rendered them insensible by means of a preparation of wine and hemp powder (Martius), or, adopting another version, by means of hemp alone. "Then, according to the case, he made openings and incisions, performed amputations, and removed the cause of mischief; he then brought together the tissues with points of suture and applied liniments."[1]

About the eleventh century of the Christian era there arose in Persia the famous sect of the *Assassins*. The persons held to be worthy of membership in this bloody community were subjected to the most seductive impressions while under the influence of haschisch, and led to believe themselves the chosen instruments of a supernatural power. The chief of the sect alone possessed the secret of its use. The novice was invited to his table and there intoxicated with this substance. He was then carried into a delicious garden where he enjoyed, as a foretaste of heaven, all those sensual and enervating delights which the Prophet has promised to his followers. At last, overcome by them and the narcotic influence of the drug, he was removed to his former situation, and on awaking was persuaded by his wily tempter, as well as by his own recollections, that he had partaken of the bliss of Paradise. Haschisch was used to produce a pleasurable intoxication, a state of ecstasy, and not, as some relate, for the purpose of throwing those to whom it was administered into a state of madness and frenzy, during the continuance of which they performed the most barbarous actions, and, running a muck, became promiscuous *assassins*. The derivation of the word is in this wise: *Haschischa*, which signifies merely *plant*, became the title of this, which was esteemed the most excellent or potent of all plants, and from it the name *Haschischin* was derived to distinguish those who, by means of its intoxicating properties, were initiated into the mysteries of the sect. Hence the modern word *assassin* has come to signify one guilty of the peculiar crime of the *Haschischin*.[2] The mischievous effects of haschisch are said to have caused its prohibition in Mohammedan countries until the fifteenth century, when Sultan Ahmed permitted its use, which soon became general, and, according to the historian, brought on the corruption and degradation of the human race.[3] Ebn Baithar states that in large doses the drug induces extreme lassitude with delirium, that its habitual use weakens the intellect in a remarkable manner, and that excessive doses produce a maniacal condition terminating in death.[4] Its effects were witnessed at Amboyna by Rumphius in 1695. He calls it *herba stultorum*, and says that throughout India the leaves and seeds are extensively used to dispel anxiety and excite agreeable dreams; that a maniacal state sometimes ensues; that he has known it to cause, when smoked with tobacco, a frantic pugnacity

[1] Snow on Anæsthetics, p. 4.
[2] M. de Sacy, Von Hammer's History of the Assassins, Lond. 1835.
[3] Bouchardat, Manuel, p. 53. [4] Edit. Southeimer, ii. 328.

in some, sardonic grins and menaces in others, and lamentations in others.[1] Nearly the same effects are ascribed by Chardin to the immoderate and protracted use of the drug among the Persians.[2]

But the use of hemp to produce intoxication is not confined to the Orientals. The plant is said to be cultivated by the Hottentots for the purpose of smoking only, and it is used in like manner by the negroes of Brazil, who doubtless brought the habit with them from Africa. In Russia, Poland, and other neighboring countries, the peasants are extremely fond of parched hemp-seed, which they eat upon black bread with a little salt, and even the nobles of these regions when hunting or travelling find it an agreeable condiment.[3] It is related that remaining long or sleeping in a field of hemp has produced feebleness of sight, vertigo, and intoxication. But such power in the hemp of temperate or cold climates may be called in question, for the product in which the active properties of the plant reside exists but scantily beyond the regions which lie within or border upon the tropics. Even in Persia, it is asserted by Kœmpfer that the hemp which grows near Ispahan and in some other places alone possesses the intoxicating qualities which have rendered it so famous, and that the seed obtained from these localities and sown elsewhere will not produce a plant of equal powers. These differences have been explained as follows.[4] The extraordinary symptoms produced by the Asiatic hemp depend on a resinous secretion with which it abounds, and which seems totally absent in the European kind. Nor, according to Mr. Jameson, does it exist even in the Indian hemp which grows upon the plains. In Central India it is said to be collected in the following manner: a man clothed in leather passes in every direction through the hemp fields, and allows the branches of the plant to brush against him, the resinous exudation adheres to his clothing, and is afterwards scraped off and rolled into balls for sale. Dr. Royle compares this glandular, resinous secretion to that which forms in the strobiles of hops and constitutes their active portion; he also states that it is collected by the natives by pressing the upper part of the young female plants between the palms of their hands, and then scraping off the exudation which adheres. According to Mongeri, a fortnight before the hemp plants are to be gathered their flowering tops are carefully removed, by which means the leaves and stalks become more fully developed. The latter are then duly gathered, dried, and afterwards grossly bruised, so as to separate the softer portions of the leaves with their resin.[5]

The principal forms in which hemp is met with in the markets of the East are, 1. *Haschisch* (which signifies *the* herb *par excellence*) is the Arabian name, and *Gunjah* the Indian appellation given to the dried tops of the plant gathered some time before the seeds reach maturity. It is resinous to the touch, and its odor is agree-

[1] Herbarium Amboinense, v. 208. [2] Murray, Apparat. Med., iii. 613.
[3] Murray, loc. cit.
[4] O'Shaughnessy, On the Preparations of the Indian Hemp.
[5] Annuaire de Thérap., 1865, p. 62.

ably narcotic.[1] 2. *Bhang*, an Indian preparation consisting of the larger leaves and capsules. It is the cheapest form used in India. 3. *Churrus*, which is the resinous secretion of the hemp mixed with a variable proportion of the leaf fibres.[2] 4. Other preparations are made by mixing the resinous product of the powdered plant itself with various aromatics and stimulants, such as opium, musk, essence of roses, and cantharides. A highly exciting compound is formed in this manner, and one well adapted to produce some of the symptoms which eastern observers ascribe to haschisch, but which the unadulterated plant and its resin do not create.

In 1839, attention was called to the properties and medicinal virtues of cannabis by Dr. O'Shaughnessy, Professor of Chemistry in the Medical College, Calcutta, who had enjoyed many apportunities of studying its effects in disease, and of witnessing the phenomena occasioned by it when used to produce intoxication. Subsequently its virtues were tested by numerous competent observers, who made good its claim to a permanent place in the materia medica.

Action. *On Animals.*—It is asserted by some authorities that the water in which hemp is steeped to prepare it for manufacture is capable of poisoning animals that drink it. A veterinary surgeon, M. Dubaud, has known seventeen horned cattle to perish from this cause in the course of three years. The French government, regarding this influence as certain, forbade the process of hemp-rotting in running water. Yet Parent-Duchâtelet states that he and his family drank with impunity water in which this operation had been carried on. The effect probably depends on the quantity of the active principle of the hemp contained in the water, and must, therefore, vary according to the extent of the reservoir, etc. in which the rotting is conducted. M. Lieutaud found in some experiments upon animals, that the preparations of hemp invariably produce in carnivorous animals and fish a sort of intoxication manifested by vacillating movements, dulness, and sluggishness, while herbivorous animals offer no sign of its influence in whatever dose it was administered.[3] The experiments made by Dr. O'Shaughnessy gave essentially the same results. In none of them, he remarks, "was there the least indication of pain, or any degree of convulsive movement observed. They all tended to demonstrate that, while carnivorous animals and fish, dogs, cats, swine, vultures, crows, and adjutants, invariably and speedily exhibited the intoxicating influence of the drug, the graminivorous, such as the horse, deer, monkey, goat, sheep, and cow, experienced but trivial effects from any dose we administered." The experiments performed by M. Mabillat led to a similar conclusion.[4]

On Man.—Of the action of haschisch many and various descrip-

[1] P. Alpinus says: "Assis nihil quidem aliud est, quam pulvis ex cannabis foliis paratus, quem cum aqua dulci mistum in massam redigunt."

[2] Dr. A. Christison, op. cit.

[3] Dieu, Matière Médicale, iii. 401 and 414, and Bouchardat, Manuel, p. 54.

[4] Des Effets Physiologiques du Chanvre, Strasbourg, 1858.

tions have been given which differ so widely among themselves that they would scarcely be supposed to apply to the same agent, had we not every day a no less remarkable instance of the same kind before us, in the case of alcohol. As the latter enlivens or saddens, excites or depresses, fills with tenderness, or urges to brutality, imparts vigor and activity, or nauseates and weakens, so does the former give rise to even a still greater variety of phenomena, according to the natural disposition of the person, and his existing state of mind, the quantity of the drug, and the combinations in which it is taken.

P. Alpinus describes briefly the effect of haschisch (assis) as being a sort of drunkenness, in which men act madly, or continue for some time in a state of ecstasy enjoying delightful visions.[1] The account furnished by Dr. O'Shaughnessy of the delirium produced by the incautious use of hemp in India, is more particular. "The state is at once recognized by the strange balancing gait of the patient, a constant rubbing of the hands, perpetual giggling, and a propensity to caress and chafe the feet of all bystanders, of whatever rank. The eye wears an expression of cunning and merriment which can scarcely be mistaken. There is no increased heat or frequency of circulation, and the skin and general functions are in a natural state." But, as was remarked, the effects vary extremely in different cases. In some, mere laziness and stupidity are induced; in others, a pleasing state of reverie without any other remarkable condition; and many break out into loud laughter, or fits of dancing and singing, and manifest venereal appetite, or an inclination to quarrel, according to their various dispositions. In many there is a remarkable desire for food, which the person eagerly devours, yet he does not appear to be satisfied, and can with difficulty control his appetite. After the stage of excitement sleep supervenes; and, on waking, the experimenter returns to his natural state, except that the ideas are often confused for a little, and in some cases vertigo is present to a slight extent.[2] M. de Chaniac[3] says that it usually exaggerates the thoughts which fill the mind at the time when it is taken, yet it generally tends to excite mirthful ideas. One of its most ordinary effects is to cause repeated bursts of laughter, which are sometimes hardly suspended for several hours.

The mental effects of cannabis when fully developed are exceedingly curious, provided the subject be one possessing the imagina-

[1] P. Alpinus speaks also of a preparation procured from India, and highly prized by the Egyptians, but whose composition is unknown. He calls it *bernavi*, and thus describes its effects: "Ab assumpta uncia hujus electuarii, homines primo hilares fieri incipiunt, multaque loquuntur, et canunt amatoria, multumque rident, aliaque deliramenta læta produnt, quæ amentia fere per horæ spatium in his perdurat: a qua iracundi fiunt, in iramque præcipitantur, effrenesque redduntur, in qua parum persistunt; demum iidem sic tristari incipiunt, tantoque mærore atque tristitia, et timore angi, ut continue plorent et lamententur, quæ paulo post, ab his deliramentis multum fessi somno correpti, digerunt, ac finiunt redeuntes ad pristinam sanitatem."—*De Med. Ægypt.*, lib. iv. cap. ii. p. 262.

[2] Dr. A. Christison, loc. cit.

[3] Annuaire de Thérap., tom. xiii.

tive faculty in a high degree. One of the best descriptions of them is the following by M. Moreau, of Tours,[1] of the effects of a full dose of the drug: "There is a slight acceleration of the pulse, with a somewhat retarded respiration, and a genial warmth diffuses itself through the body with the exception of the feet, which are generally chill. The wrists and forearms seem as if loaded with a weight, and movements are automatically performed as if to shake them free. At the same time, vague muscular sensations (known in English by the expressive term *fidgets*), prompting to continual restlessness, are experienced in the lower extremities. A very common feeling is that of the brain boiling over and lifting the cranial arch like the lid of a teakettle. . . . . These and other disagreeable feelings generally both precede and follow the *fantasia*, as it is called, or the dreamy ecstasy, to enjoy which the drug is generally taken. It is really *happiness* which is produced by the haschisch, and by this is implied an enjoyment entirely intellectual, and by no means sensual, as we might be induced to suppose. The haschisch-eater is happy, not like the gourmand or the famished man when satisfying his appetite, or the voluptuary in the gratification of his amative desires, but like him who hears tidings that fill him with joy," etc.; in other words, he is absorbed by a consciousness or internal sensation of happiness without reference to any definite cause producing it, or any object to which it tends.

M. Aubert describes the influence of haschisch upon himself in the following terms: "I was engaged in conversation when I felt a prickling sensation in my feet, and in my head a stricture which gave way suddenly, and my skull seemed empty. Every object wore a new aspect; my companion's face assumed a grotesque appearance; I burst out a laughing, and continued to laugh for almost an hour. The merest trifle renewed my mirth. Meanwhile the most various and whimsical ideas coursed swiftly through my mind. I experienced the most perfect sense of comfort. For me there was no longer past, present, or future; the fleeting moment limited my whole existence. Then followed a calm, and sleep stole over me. The whole night was but one long delightful dream. On awaking, I remembered perfectly all that had taken place, and my head was not heavy nor my mouth dry, as it would have been after a debauch in opium or wine."[2]

Dr. A. Christison made several experiments with the extract of cannabis, and, in the paper above referred to, has related their results, of which the following is a summary: "On trying Mr. Robertson's extract once for toothache, I found that about four grains taken about 3 A. M. caused in an hour cessation of pain, a pleasant numbness of the limbs, giddiness, a rapid succession of unassociated ideas, and impossibility to follow a train of thought,

[1] Brit. and For. Med. Rev., Jan. 1847.

[2] Dieu, op. cit., p. 411. Some other illustrations will be found in Bull. de Thérap., xxxiii. 248; Dierbach, op. cit., iii. 1169; Pereira, Mat. Med., ii. 213; Br. and For. Med.-Chir. Rev., Oct. 1860, p. 524; S. de Luca, Annuaire de Thérap., xxiii. 34; Dr. Campbell, Times and Gaz., Aug. 1863, p. 194.

frequent intervals of sleep, and slight increase in the force of the pulse. Next morning there was an ordinary appetite, much torpidity, great defect and shortness of memory, extreme apparent protraction of time, but no peculiarity of articulation or other effect; and these symptoms lasted until 2 P. M., when they ceased entirely in a few minutes after taking lemonade. . . . On another occasion, I took one grain of the extract dissolved in spirit. I felt a peculiar numbness creeping through my body and limbs. On lying down, the numbness continued, but in fifteen minutes my sensations became agreeable. I laughed heartily several times, answered questions incoherently, and immediately forgot what they were about, and what I had answered. Delightful reveries came over me, and whatever I looked at became lost, as it were, in a maze; the lamp appeared to be slowly turning round, and when I lost sight of this, the red lines on the paper of the room appeared to intertwine in a most beautiful manner. The most remarkable effect was the constant succession of new ideas, each of which was almost instantly forgotten. When roused to tea, I ate ravenously without feeling satisfied. I slept soundly at night afterwards, and the next day was stupid and forgetful, but was much improved by drinking lemon-juice."

It would unduly extend this description to present even an abstract of the interesting experiments performed by Schroff and by Mabillat;[1] they developed all the phenomena which have been signalized by the observers already quoted, and also some which have been less fully described by other writers. In particular, general sensibility was materially affected. Under the primary influence of the drug, the whole body was the seat of sensations compared to those produced by slight electric sparks, and an acrid heat was felt wherever the skin was pressed. Subsequently, there was universal anæsthesia, while the mind continued clear; there was no consciousness of the contact of the feet with the ground, or of other parts of the body with surrounding objects; the very muscular sense appeared enfeebled or lost, and that of pain was blunted or entirely destroyed.

Dr. John Bell, of New Hampshire, in a very interesting account of the effects produced by the drug upon himself, alludes particularly to a sort of double consciousness, in which, while the sense of personality was perfect, the reality of the strange sensations felt, and of the visionary objects seen, appeared to be equally absolute. This, however, gradually merged into the fullest and most complete belief in the actual existence of a thousand hallucinations.[2] The double consciousness here described has also been experienced by other experimenters.[3]

In several of the accounts that have now been cited, allusion is made to the power of hemp to stimulate the venereal propensities.

[1] Des Effets Physiologiques du Chanvre. Strasbourg. 1858.
[2] Boston Med. and Surg. Journ., April, 1857, p. 209.
[3] Campbell, Times and Gaz., Aug. 1863, p. 194.

A writer states that during a residence at Tetuan, in Barbary, he learned that the Moors are said to use the drug as an aphrodisiac, and ascertained that among the Jews it was taken secretly by very many as an excitant to venery. But for this purpose it seems to have been combined in a conserve with opium. Sterility among the women and impotence among the men are exceedingly common in Barbary, so that, according to this author, one out of every twelve of the married Jewesses in that country is either barren or has borne only one child.[1] Experiments fairly tried by M. Roubaud seem to prove that this drug does not excite, but, on the contrary, impairs the venereal propensity and power; and that the visions it conjures up delight the imagination and regale the senses.[2]

The preceding extracts present the most interesting phenomena produced by the administration of cannabis. They correspond very nearly with those which the Orientals seek to produce by means of this drug. But a different class of symptoms is sometimes occasioned by its use. Dr. Lawrie, physician to the Lock Hospital, of Glasgow, reports twenty-six cases in which cannabis was administered.[3] In reviewing them the reader is struck by the almost total absence of that pleasureable intoxication described above. In many nausea and vomiting were produced; in several there were convulsive paroxysms; frequently the thirst was distressing; the pulse was rendered frequent, weak, and intermittent; the pupils were largely dilated, and, on the whole, the effects of the drug were so far from agreeable that "the majority of those who took it once only did so a second time on compulsion." The contrast of these with the above-related results is very remarkable, and the more so because many of Dr. L.'s patients belonged to a class of persons habitually greedy of stimulants. Dr. Christison, in noticing these cases, insists that they are exceptional ones, and moreover that all the patients were females, and that the medicine was not administered in sufficiently large doses. But, assuming that the preparation used was genuine, it appears more rational, because more consistent with experience in regard to cerebral stimulants in general, to explain these discrepancies by a reference to the mental habits of the persons in whom the phenomena occasioned by hemp were observed. The impressionable and imaginative Oriental and the highly educated and refined European must, under any cause of mental excitement, display a very different class of phenomena from the illiterate peasant, or the wretched and generally ignorant creatures who formed the subjects of Dr. Lawrie's experiments. A similar contrast has been alluded to in the history of opium, and it would be far more extraordinary that persons of such opposite mental conditions should exhibit identical symptoms from the same stimulus than that they should be affected in the manner that has been described.

[1] Month. Journ. of Med. Sci., i. 58.
[2] De l'Impuissance, p. 309. [3] Month. Journ. of Med. Sci., iv. 939.

The habitual use of this drug entails consequences no less mischievous than are produced by alcohol and opium; the face becomes bloated, the eyes injected, the limbs weak and tremulous, the mind sinks into a state of imbecility, and death by marasmus is the ultimate penalty paid for the overstrained pleasures it imparts.

We are not acquainted with any instance of death directly resulting from the poisonous action of cannabis. But several cases are recorded which illustrate its effects in excessive doses.

In one, a Moor, of Algiers, under the influence of undue indulgence in smoking haschisch, became furious, and assaulted a number of Jews, seven of whom were more or less seriously injured, and one died. He afterwards professed that he remembered nothing whatever of the occurrence.[1]

In several other cases there was observed loss of consciousness, with collapse or stupor, an insensible pupil, a pale, clammy, and insensible skin, extreme debility, and a small, feeble pulse. In one instance a fear of death and belief that it was imminent were observed, and in another, that of a Mussulman, there was a well-marked cataleptic condition, so that any limb remained elevated, flexed, or in whatever position it was placed by the attendants.[2] Dr. F. H. Brown relates that a druggist's clerk took six grains of the solid extract in divided doses within the space of an hour and a quarter. Until two hours and a quarter later no effect was produced, when dizziness and confusion of mind supervened, an irresistible desire to run, strangury, and excessive thirst. Spasms of various muscles, or of the whole body, resembling salaam convulsions, followed, the feet beat a tattoo upon the floor, or the knees smote together. There was no loss of consciousness or delirium, but some grotesque hallucinations. The desire for constant motion and occasionally a slight spasm continued for twenty-four hours, but soon after passed away.[3] A similar case is reported by Dr. Reidel, of Berlin. The subject of it was also a druggist's apprentice, who within an hour or two swallowed between thirty and forty-five grains of extract of cannabis, with a view of enjoying that delicious intoxication of which he had read. An hour afterwards his head was hot, his face intensely red, the eyes half open and staring, the conjunctiva injected, the pupils natural, and the expression of countenance malicious. The heart's impulse was vehement; the pulse, of moderate strength and fulness, beat 96; the heart-sounds normal. The respiration was natural; the hands and feet cool, and very red. The patient evidently recognized those about him, but his language was rude and his manner violent. Repeated emetics compelled him to disgorge the greater part of the drug which he had swallowed, soon after which he became more calm and natural, but with heaviness of the head and oppres-

[1] Brit. and For. Med.-Chir. Rev., xxi. 535.

[2] Compare Edinb. Month. Journ., March, 1852, p. 279; Dublin Quart. Journ., Aug 1858, p. 229; and Times and Gaz., Feb. 1859, p. 185.

[3] Boston Med. and Surg. Journ., Nov. 1862, p. 291.

sion about the heart. After a sound sleep of many hours he awoke somewhat benumbed and dizzy, but otherwise quite well. His memory of the circumstances of his illness was entirely a blank, except as to a desire, at the beginning, to move about. He had experienced not the least degree of the voluptuous delirium he had coveted.[1] From a review of these various illustrations of the action of cannabis, it is evident that the drug possesses no direct narcotic power, although it may materially contribute to promote sleep by its anodyne property and by its power of substituting agreeable visions and thoughts for those which irritate and harass. Fronmüller, in a very complete account of the action and uses of cannabis, makes the following comparison between it and opium.[2] It does not directly impair the appetite or digestion, nor diminish the secretions; it does not occasion nausea nor vomiting, nor excite the circulation, nor produce congestion of the brain; it slightly lowers the temperature of the skin, but excites no pruritus, as opium does; it does not contract the pupil, and it promotes sleep, as we have just remarked, by relieving the mind from external impressions. The anæsthetic virtues of cannabis which were anciently, and in Oriental countries quite recently, employed to dull the pain of surgical operations, are illustrated in its ordinary intoxicating effects, such as the patient's indifference to external things or his misapprehension of them, and especially the loss of the sense of touch in the feet, whereby one seems to walk in the air or upon a soft and undulating surface. At the same time there is produced a sort of mental anæsthesia, by which the perception of the relations of things, and especially of the lapse of time, is more or less impaired, so that the moments seem hours or days, and the whole period of intoxication stretches out to ages. This is partly due to the prodigious variety of mental impressions which follow one another, and partly to absence of the regulating power exerted by external objects upon the mind.[3] The action of cannabis produced in Europe and in the United States is identical in kind with that of the Oriental variety, but somewhat less intense in degree. In the experiments of Albert[4] this identity was abundantly proved, but still more fully illustrated by those of Dr. H. C. Wood, of Philadelphia.[5] This observer has published a full and very graphic description of the effects of the hemp upon himself, in which we find the sudden access of intoxication several hours after the drug had been taken, the bouyancy of feeling, the rapid flow of ideas, the anæsthesia, and the lost perception of time, so that "seconds seemed hours, minutes seemed days, and hours seemed infinite," were all produced in a full degree by the indigenous product.

[1] New York Med. Journ., iv. 142. [2] Prager Vierteljahrs., lxv. 102.

[3] Observations and experiments of great interest relating to the present subject will be found in MABILLAT, Effets Physiologiques du Chanvre, Strasbourg, 1858; MONGERÉ, Ann. de Thérapeutique, 1865, p. 59; GRIMAUX, du Haschisch, 1865; RICHARDSON and POLLI, Trans. St. Andrew's Med. Grad. Assoc., 1869, p. 90.

[4] MABILLAT, op. cit.

[5] On the medical activity of the hemp plant, as grown in North America, 1869.

Remedial Employment.—As a remedy for disease, cannabis has been chiefly applied to spasmodic and painful affections, and in several of these its curative powers are unquestionable; but whether they can be placed upon the same level with opium, or even belladonna, is a question which can scarcely at present be answered in the affirmative. Since, however, these medicines cannot be administered in very large doses, without some risk to life, it is probable that cases may occur in which the superior safety of cannabis may compensate for its inferior power, and therefore it may appropriately occupy a place in the Materia Medica.

Tetanus.—The examples of this affection recorded by Dr. O'Shaughnessy undoubtedly demonstrate, as the author remarks, that when given boldly, in large doses, the resin of hemp is capable of arresting the progress of this formidable disease, and in a large proportion of cases of effecting a perfect cure. The cases alluded to were all of the traumatic form. The following may be taken as a specimen. A female, æt. 25, had had tetanus for three days, the consequence of a cut received upon the elbow a fortnight before. When admitted into the hospital the symptoms were violent, and on the evening of the same day three grains of hemp resin were given her at bedtime, and repeated on the following day. The next morning she was found in a state of complete catalepsy, and remained so until evening, when she became sensible, and a tetanic paroxysm recurred. The hemp was resumed, and continued in two-grain doses every fourth hour. From this time until the third dose was taken no tetanic symptoms returned. She subsequently took a grain twice a day until the fifth week after her admission, when she left the hospital apparently quite well. Prof. Miller, of Edinburgh, says: "My own experience speaks loudly in favor of the hemp. I can now record three fortunate cases under its use, all traumatic tetanus, and a case which proved fatal, but where great alleviation of suffering was produced." Dr. Chuckerbutty has reported the cure of seven out of thirteen cases of tetanus by the tincture of hemp administered in doses of thirty or forty minims every two or three hours.[1] In some of the cases a tolerance of the remedy was observed similar to what occurs under like circumstances when the disease is treated with opium. Later experience has confirmed the opinions here given respecting the value of cannabis in traumatic tetanus.

Two cases of trismus nascentium are reported by Dr. P. C. Gaillard,[2] and of the traumatic form of tetanus one case by Mr. Skues,[3] one by Mr. Cock,[4] and one by Dr. Bailey,[5] as cured by cannabis.

It is proper to add that in several cases reported by Dr. Duncan and others there was neither palliation nor cure of the disease; but, owing to the complete absence of the symptoms peculiar to intoxication by cannabis, there is reason to surmise that a feeble or even a worthless preparation was administered.

[1] Practitioner, i. 378.
[2] Charleston Med. Journ., viii. 808.
[3] Edinb. Med. Journ., iii. 877.
[4] Times and Gaz., July, 1858, p 8.
[5] Charleston Med. Journ., xiv. 348.

Neuralgia, *Rheumatism*, *etc.*—In the first-named disease the preparations of hemp have been found to palliate the symptoms very generally, and in not a few instances to effect a perfect cure. Dr. Donovan has reported many such,[1] and Dr. Clendinning,[2] Sir James Murray,[3] and Dr. C. J. B. Williams have added to the number; but whether the preparation used by them was not strong enough, or not always given in sufficiently large doses, its effects were certainly not comparable to those of belladonna or stramonium in the same affection. In some cases of *rheumatism* the action of cannabis appears to have been salutary, yet so far inferior to that of the more familiar remedies for this disease, as to entitle it to a very secondary position in the long list of anti-rheumatic medicines.

In *chorea*, Dr. Williams found that cannabis palliated the agitation of the muscles, but exerted no decidedly curative influence.[4] Dr. Corrigan, however, has published three cases, one of which was inveterate, but all of them were cured by this medicine;[5] and Dr. Storer one of several months' duration, and which became worse under the administration of carbonate of iron, but rapidly improved and finally recovered when the tincture of cannabis was given in doses of six drops three times a day.[6] Subsequent reports of the treatment of chorea by cannabis tend to prove that this disease is as little modified by it as by any of the drugs which have been reputed to be adapted to its cure. All of them may claim some successes, but none of them have a peculiar or specific control over the disease.

As a *hypnotic* it is recommended by Dr. A. Christison, especially where opium from long-continued use has ceased to produce its proper effects. The same writer mentions a case in which the medicine entirely allayed the intense itching of eczema while the patient continued under its effects, and procured for him a refreshing sleep which no other means could obtain. Berthier asserts its superior efficacy in procuring sleep for the insane. He prescribed three and a half grains of the alcoholic extract the first night, seven grains the second, and ten the third night.[7] The influence of cannabis in dissipating *hallucinations* of vision and hearing has been very marked in some cases reported by Moreau.[8]

The exhilarating effects of cannabis led M. Moreau to conjecture that it might prove a valuable remedy in *melancholy*, and in some trials that he made of it, a temporary amendment resulted. Polli claims to have cured a case of melancholy of a very aggravated description by its use. In the course of ten days the patient took above 77 grains of brown extract of Indian hemp. M. Brierre de Boismont made similar experiments, but without any encouraging results. Cannabis has also been employed with satisfactory effects

[1] Dublin Med. Journ., Jan. 1845. [2] Med. Times, No. 192.
[3] Dublin Med. Press, March, 1843.
[4] Lancet, 1842–43, ii. 266.
[5] Med. Times, and Bull. de Thérap., xlviii. 234.
[6] Boston Med. and Surg. Journ., Oct. 1855, p. 209.
[7] Bull. de Thérap., lxxiii. 185. [8] Ibid., li. 283, 375.

in the treatment of *delirium tremens* by Mr. Tyrrell, of Dublin,[1] and by Dr. Beddoe.[2] A grain of the extract, or twenty drops of the tincture, may be given at once, and repeated at first in two or three hours, and afterwards at hourly intervals until a tendency to sleep is manifested.

In opposition to these results must be cited the careful digest of his experience furnished by Dr. Reynolds.[3] He found Indian hemp unsuccessful in the following affections, viz., hypochondriasis, temporary religious melancholy, insomnia with diabetes, sciatica, hysterical hip, hysterical headache, and epilepsy; but it proved successful in deranged cerebral circulation with pain and delirium, incipient insanity after yellow fever, and senile softening of the brain, in pain from nervous irritation of carious teeth, from probable tumor of the brain, from probable thickening of the spinal meninges, from hemorrhage at the roots of the eighth and ninth nerves, from syphilitic meningitis, and from hemicrania, in deranged motility from meningitis and from cerebral congestion, in obstinate nervous vomiting, and in recurrent convulsions. In other words, it acted least favorably in purely functional disorders, and most advantageously where organic disease existed.

From some experiments, cannabis would appear to excite contractions of the uterus. Dr. Churchill states that it has been successfully tried by himself and other physicians in Dublin, to moderate or arrest *uterine hemorrhage*, such as is so apt to occur at the period of the cessation of the menses. The preparation used was the tincture of the resin, and was given in doses of from five to fifteen or twenty drops three times a day. Its effects in many cases were very marked, often instantaneous, but generally complete after three or four hours. Dr. Silver, of London, has published an account of several cases which fully confirm the preceding statements; they were examples of menorrhagia and dysmenorrhœa occurring under various conditions, including the presence of uterine tumors. In the last-named instances the effect of the medicine was of necessity only temporary.[4] In some few cases of ulceration of the womb with hemorrhage, it seemed to be equally beneficial. Preparations of hemp are reported to resemble ergot in another respect. It was found by Dr. Christison to possess a remarkable power of increasing the force of *uterine contraction* during labor. It augmented the intensity and sometimes the duration of the pains, and shortened the intervals between them. These effects of cannabis come on more quickly than those of ergot; they are more energetic, and perhaps more certainly induced, but at the same time of shorter duration. Unfortunately, however, they are far from certain to follow the administration of the drug. Dr. John Grigor administered it in sixteen cases, but in nine of these no increased uterine action was perceptible, while in the remaining five it increased the contractions in strength and frequency. It did not manifest any anæsthetic effect. The preparation

[1] Med. Press and Cir., March, 1867.
[2] Ibid., Oct. 1867.
[3] Beale's Archives, ii. 154.
[4] Times and Gaz., July, 1870, p. 59.

employed was a solution of 24 grs. of the extract in an ounce of alcohol, of which from 25 to 35 drops were given at a time.[1]

Administration.—The purified extract in the form of pill produces the most gradual effect, but its action is not very certain. Its dose is from half a grain to two or more grains. The tincture may be taken in doses of five drops and upwards in sweetened aromatic water, with the addition of a few drops of ammonia to hold it in solution. But whatever form is used, it should first be proved to possess active properties by experimental doses given to healthy persons. Lemon-juice, according to Dr. Christison and other writers, has the power of modifying the intoxicating effects of cannabis, and even of suspending them entirely. An emetic of salt and water is said to remove the intoxication at once. Even spontaneous vomiting diminishes it sensibly. In the East, tobacco and coffee are used to increase and sustain the action of the drug.

[1] Month. Journ. of Med. Sci., Aug. 1852, p. 124.

END OF VOL. I.

HENRY C. LEA'S

(LATE LEA & BLANCHARD'S)

CLASSIFIED CATALOGUE

OF

MEDICAL AND SURGICAL PUBLICATIONS.

In asking the attention of the profession to the works advertised in the following pages, the publisher would state that no pains are spared to secure a continuance of the confidence earned for the publications of the house by their careful selection and accuracy and finish of execution.

The printed prices are those at which books can generally be supplied by booksellers throughout the United States, who can readily procure for their customers any works not kept in stock. Where access to bookstores is not convenient, books will be sent by mail post-paid on receipt of the price, but no risks are assumed either on the money or the books, and no publications but my own are supplied. Gentlemen will therefore in most cases find it more convenient to deal with the nearest bookseller.

An ILLUSTRATED CATALOGUE, of 64 octavo pages, handsomely printed, will be forwarded by mail, postpaid, on receipt of ten cents.

HENRY C. LEA.

Nos. 706 and 708 SANSOM ST., PHILADELPHIA, October, 1874.

ADDITIONAL INDUCEMENT FOR SUBSCRIBERS TO

THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES.

TWO MEDICAL JOURNALS, containing over 2000 LARGE PAGES,

Free of Postage, for SIX DOLLARS Per Annum.

TERMS FOR 1874:

THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, and THE MEDICAL NEWS AND LIBRARY, both free of postage, } Five Dollars per annum, in advance.

OR

THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, published quarterly (1150 pages per annum), with
THE MEDICAL NEWS AND LIBRARY, monthly (384 pp. per annum), and
THE SUPPLEMENT TO THE MEDICAL NEWS AND LIBRARY, monthly (592 pages per annum).
} Six Dollars per annum in advance.

SEPARATE SUBSCRIPTIONS TO

THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, subject to postage when not paid for in advance, Five Dollars.

THE MEDICAL NEWS AND LIBRARY, free of postage, in advance, One Dollar.

THE MEDICAL NEWS AND LIBRARY, with the SUPPLEMENT, free of postage, in advance, Three Dollars and a Half.

It is manifest that only a very wide circulation can enable so vast an amount of valuable practical matter to be supplied at a price so unprecedentedly low. The publisher, therefore, has much gratification in stating that the rapid and steady increase in the subscription list promises to render the enterprise a permanent one, and it is with especial pleasure that he acknowledges the valuable assistance spontaneously rendered by so many of the old subscribers to the "JOURNAL," who have kindly made known among their friends the advantages thus offered and have induced them to subscribe. Relying upon a continuance of these friendly exertions, he hopes to be able to maintain the unexampled rates at which these works are now offered, and to

---

(For "THE OBSTETRICAL JOURNAL," see p. 22.)

succeed in his endeavor to place upon the table of every reading practitioner in the United States the equivalent of three large octavo volumes, at the comparatively trifling cost of SIX DOLLARS *per annum*.

These periodicals are universally known for their high professional standing in their several spheres.

I.

THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES,

EDITED BY ISAAC HAYS, M. D.,

is published Quarterly, on the first of January, April, July, and October. Each number contains nearly three hundred large octavo pages, appropriately illustrated, wherever necessary. It has now been issued regularly for over FIFTY years, during almost the whole of which time it has been under the control of the present editor. Throughout this long period, it has maintained its position in the highest rank of medical periodicals both at home and abroad, and has received the cordial support of the entire profession in this country. Among its Collaborators will be found a large number of the most distinguished names of the profession in every section of the United States, rendering the department devoted to

ORIGINAL COMMUNICATIONS

full of varied and important matter, of great interest to all practitioners. Thus, during 1873, articles have appeared in its pages from nearly one hundred gentlemen of the highest standing in the profession throughout the United States.*

Following this is the "REVIEW DEPARTMENT," containing extended and impartial reviews of all important new works, together with numerous elaborate "ANALYTICAL AND BIBLIOGRAPHICAL NOTICES" of nearly all the medical publications of the day.

This is followed by the "QUARTERLY SUMMARY OF IMPROVEMENTS AND DISCOVERIES IN THE MEDICAL SCIENCES," classified and arranged under different heads, presenting a very complete digest of all that is new and interesting to the physician, abroad as well as at home.

Thus, during the year 1873, the "JOURNAL" furnished to its subscribers Seventy-seven Original Communications, One Hundred and Twenty-five Reviews and Bibliographical Notices, and Two Hundred and Ninety-four articles in the Quarterly Summaries, making a total of about FIVE HUNDRED articles emanating from the best professional minds in America and Europe.

That the efforts thus made to maintain the high reputation of the "JOURNAL" are successful, is shown by the position accorded to it in both America and Europe as a national exponent of medical progress :—

America continues to take a great place in this class of journals (quarterlies), at the head of which the great work of Dr. Hays, the *American Journal of the Medical Sciences*, still holds its ground, as our quotations have often proved.—*Dublin Med. Press and Circular*, Jan. 31, 1872.

Of English periodicals the *Lancet*, and of American the *Am. Journal of the Medical Sciences*, are to be regarded as necessities to the reading practitioner.—*N. Y. Medical Gazette*, Jan. 7, 1871.

The *American Journal of the Medical Sciences* yields to none in the amount of original and borrowed matter it contains, and has established for itself a reputation in every country where medicine is cultivated as a science.—*Brit. and For. Med.-Chirurg. Review*, April, 1871.

This, if not the best, is one of the best-conducted medical quarterlies in the English language, and the present number is not by any means inferior to its predecessors.—*London Lancet*, Aug 23, 1873.

Almost the only one that circulates everywhere, all over the Union and in Europe.—*London Medical Times*, Sept. 5, 1868.

And by the fact, that it was specifically included in the award of a medal of merit to the publisher at the Vienna Exhibition in 1873.

The subscription price of the "AMERICAN JOURNAL OF THE MEDICAL SCIENCES" has never been raised, during its long career. It is still FIVE DOLLARS per annum; and when paid for in advance, the subscriber receives in addition the "MEDICAL NEWS AND LIBRARY," making in all about 1500 large octavo pages per annum, free of postage.

II.

THE MEDICAL NEWS AND LIBRARY

is a monthly periodical of Thirty-two large octavo pages, making 384 pages per annum. Its "NEWS DEPARTMENT" presents the current information of the day, with Clinical Lectures and Hospital Gleanings; while the "LIBRARY DEPARTMENT" is devoted to publishing standard works on the various branches of medical science, paged

* Communications are invited from gentlemen in all parts of the country. Elaborate articles inserted by the Editor are paid for by the Publisher.

separately, so that they can be removed and bound on completion. In this manner subscribers have received, without expense, such works as "WATSON'S PRACTICE," "TODD AND BOWMAN'S PHYSIOLOGY," "WEST ON CHILDREN," "MALGAIGNE'S SURGERY," &c. &c. In July, 1873, was commenced the publication of Dr. WILSON FOX'S valuable work "ON THE DISEASES OF THE STOMACH" (see p. 16), which will be completed in December, 1874, and will be followed in 1875 by Dr. STOKES'S new work on FEVER (see p. 14).

As stated above, the subscription price of the "MEDICAL NEWS AND LIBRARY" is ONE DOLLAR per annum in advance; and it is furnished without charge to all advance paying subscribers to the "AMERICAN JOURNAL OF THE MEDICAL SCIENCES."

III.

SUPPLEMENT TO THE MEDICAL NEWS AND LIBRARY.

The publication in England of Ranking's "HALF-YEARLY ABSTRACT OF THE MEDICAL SCIENCES" having ceased with the volume for January, 1874, its place will be supplied in this country by a monthly "ABSTRACT OF THE MEDICAL SCIENCES" in the shape of a SUPPLEMENT to the "MEDICAL NEWS AND LIBRARY," containing forty-eight large octavo pages each month, thus furnishing in the course of the year about six hundred pages, the same amount of matter as heretofore embraced in the Half-Yearly Abstract. As the discontinuance of the Abstract arose from the multiplication of journals appearing more frequently and presenting the same character of material, it has been thought that this plan of monthly issues will better meet the wants of subscribers who will thus receive earlier intelligence of the improvements and discoveries in the medical sciences. The aim of the SUPPLEMENT will be to present a careful abstract of all that is new and important in the medical journalism of the world, and all the prominent professional periodicals of both hemispheres will be at the disposal of the Editors.

Subscribers desiring to bind the SUPPLEMENT, will receive on application at the end of each year, a cloth cover, gilt lettered, for the purpose, or it will be sent free by mail on receipt of the postage, which, under existing laws, will be six cents.

The subscription to the "MEDICAL NEWS" and its "SUPPLEMENT," free of postage, will be Three Dollars and a Half a year, in advance, containing in all nearly a thousand pages per annum.

As stated above, however, they will be supplied in conjunction with the "AMERICAN JOURNAL OF THE MEDICAL SCIENCES," making in all about TWENTY-ONE HUNDRED pages per annum, the whole *free of postage*, for SIX DOLLARS a year, in advance.

As the January volume of the "HALF-YEARLY ABSTRACT" has supplied to subscribers what is due to them for half of the year 1874, the Supplement to the News and Library will be commenced with July, 1874.

In this effort to bring so large an amount of practical information within the reach of every member of the profession, the publisher confidently anticipates the friendly aid of all who are interested in the dissemination of sound medical literature. He trusts, especially, that the subscribers to the "AMERICAN MEDICAL JOURNAL" will call the attention of their acquaintances to the advantages thus offered, and that he will be sustained in the endeavor to permanently establish medical periodical literature on a footing of cheapness never heretofore attempted.

PREMIUM FOR NEW SUBSCRIBERS.

Any gentleman who will remit the amount for two subscriptions for 1875, one of which must be for a *new subscriber*, will receive as a PREMIUM, free by mail, a copy of STURGES' CLINICAL MEDICINE (for advertisement of which see p. 14), or of the new edition of SWAYNE'S OBSTETRIC APHORISMS (see p. 24), or of TANNER'S CLINICAL MANUAL (see p. 5), or of CHAMBERS' RESTORATIVE MEDICINE (see p. 15), or of WEST ON NERVOUS DISORDERS OF CHILDREN (see p. 21).

*** Gentlemen desiring to avail themselves of the advantages thus offered will do well to forward their subscriptions at an early day, in order to insure the receipt of complete sets, as the constant increase in the subscription list almost always exhausts the quantity printed shortly after publication.

☞ The safest mode of remittance is by bank check or postal money order, drawn to the order of the undersigned. Where these are not accessible, remittances for the "JOURNAL" may be made at the risk of the publisher, by forwarding in REGISTERED letters. Address,

HENRY C. LEA,

Nos. 706 and 708 SANSOM ST., PHILADELPHIA, PA.

DUNGLISON (ROBLEY), M.D.,

Late Professor of Institutes of Medicine in Jefferson Medical College, Philadelphia.

MEDICAL LEXICON; A DICTIONARY OF MEDICAL SCIENCE: Containing a concise explanation of the various Subjects and Terms of Anatomy, Physiology, Pathology, Hygiene, Therapeutics, Pharmacology, Pharmacy, Surgery, Obstetrics, Medical Jurisprudence, and Dentistry. Notices of Climate and of Mineral Waters; Formulæ for Officinal, Empirical, and Dietetic Preparations; with the Accentuation and Etymology of the Terms, and the French and other Synonymes; so as to constitute a French as well as English Medical Lexicon. A New Edition. Thoroughly Revised, and very greatly Modified and Augmented. By RICHARD J. DUNGLISON, M.D. In one very large and handsome royal octavo volume of over 1100 pages. Cloth, $6 50; leather, raised bands, $7 50. (*Just Ready.*)

The object of the author from the outset has not been to make the work a mere lexicon or dictionary of terms, but to afford, under each, a condensed view of its various medical relations, and thus to render the work an epitome of the existing condition of medical science. Starting with this view, the immense demand which has existed for the work has enabled him, in repeated revisions, to augment its completeness and usefulness, until at length it has attained the position of a recognized and standard authority wherever the language is spoken.

Special pains have been taken in the preparation of the present edition to maintain this enviable reputation. During the ten years which have elapsed since the last revision, the additions to the nomenclature of the medical sciences have been greater than perhaps in any similar period of the past, and up to the time of his death the author labored assiduously to incorporate everything requiring the attention of the student or practitioner. Since then, the editor has been equally industrious, so that the additions to the vocabulary are more numerous than in any previous revision. Especial attention has been bestowed on the accentuation, which will be found marked on every word. The typographical arrangement has been much improved, rendering reference much more easy, and every care has been taken with the mechanical execution. The work has been printed on new type, small but exceedingly clear, with an enlarged page, so that the additions have been incorporated with an increase of but little over a hundred pages, and the volume now contains the matter of at least four ordinary octavos.

A book well known to our readers, and of which every American ought to be proud. When the learned author of the work passed away, probably all of us feared lest the book should not maintain its place in the advancing science whose terms it defines. Fortunately, Dr. Richard J. Dunglison, having assisted his father in the revision of several editions of the work, and having been, therefore, trained in the methods and imbued with the spirit of the book, has been able to edit it, not in the patchwork manner so dear to the heart of book editors, so repulsive to the taste of intelligent book readers, but to edit it as a work of the kind should be edited—to carry it on steadily, without jar or interruption, along the grooves of thought it has travelled during its lifetime. To show the magnitude of the task which Dr. Dunglison has assumed and carried through, it is only necessary to state that more than six thousand new subjects have been added in the present edition. Without occupying more space with the theme, we congratulate the editor on the successful completion of his labors, and hope he may reap the well-earned reward of profit and honor.—*Phila. Med. Times*, Jan 3, 1874.

About the first book purchased by the medical student is the Medical Dictionary. The lexicon explanatory of technical terms is simply a *sine qua non*. In a science so extensive, and with such collaterals as medicine, it is as much a necessity also to the practising physician. To meet the wants of students and most physicians, the dictionary must be condensed while comprehensive, and practical while perspicacious. It was because Dunglison's met these indications that it became at once the dictionary of general use wherever medicine was studied in the English language. In no former revision have the alterations and additions been so great. More than six thousand new subjects and terms have been added. The chief terms have been set in black letter, while the derivatives follow in small caps; an arrangement which greatly facilitates reference. We may safely confirm the hope ventured by the editor "that the work, which possesses for him a filial as well as an individual interest, will be found worthy a continuance of the position so long accorded to it as a standard authority."—*Cincinnati Clinic*, Jan. 10, 1874.

We are glad to see a new edition of this invaluable work, and to find that it has been so thoroughly revised, and so greatly improved. The dictionary, in its present form, is a medical library in itself, and one of which every physician should be possessed.—*N. Y. Med. Journal*, Feb. 1874.

With a history of forty years of unexampled success and universal indorsement by the medical profession of the western continent, it would be presumption in any living medical American to essay its review. No reviewer, however able, can add to its fame: no captious critic, however caustic, can remove a single stone from its firm and enduring foundation. It is destined, as a colossal monument, to perpetuate the solid and richly deserved fame of Robley Dunglison to coming generations. The large additions made to the vocabulary, we think, will be welcomed by the profession as supplying the want of a lexicon fully up with the march of science, which has been increasingly felt for some years past. The accentuation of terms is very complete, and, as far as we have been able to examine it, very excellent. We hope it may be the means of securing greater uniformity of pronunciation among medical men.—*Atlanta Med. and Surg. Journ.*, Feb. 1874.

It would be mere waste of words in us to express our admiration of a work which is so universally and deservedly appreciated. The most admirable work of its kind in the English language.—*Glasgow Medical Journal*, January, 1866.

A work to which there is no equal in the English language.—*Edinburgh Medical Journal.*

Few works of the class exhibit a grander monument of patient research and of scientific lore. The extent of the sale of this lexicon is sufficient to testify to its usefulness, and to the great service conferred by Dr. Robley Dunglison on the profession, and indeed on others, by its issue.—*London Lancet*, May 13, 1865.

It has the rare merit that it certainly has no rival in the English language for accuracy and extent of references.—*London Medical Gazette.*

HOBLYN (RICHARD D.), M.D

A DICTIONARY OF THE TERMS USED IN MEDICINE AND THE COLLATERAL SCIENCES. Revised, with numerous additions, by ISAAC HAYS, M.D., Editor of the "American Journal of the Medical Sciences." In one large royal 12mo volume of over 500 double-columned pages: cloth, $1 50; leather, $2 00

[illegible] book of reputation we have, and [illegible] to be upon the students' table.—*Southern Med. and Surg. Journal.*

NEILL (JOHN), M.D., and SMITH (FRANCIS G.), M.D.,

Prof. of the Institutes of Medicine in the Univ. of Penna

AN ANALYTICAL COMPENDIUM OF THE VARIOUS BRANCHES OF MEDICAL SCIENCE; for the Use and Examination of Students. A new edition, revised and improved. In one very large and handsomely printed royal 12mo. volume, of about one thousand pages, with 374 wood cuts, cloth, $4; strongly bound in leather, with raised bands, $4 75.

The Compend of Drs. Neill and Smith is incomparably the most valuable work of its class ever published in this country. Attempts have been made in various quarters to squeeze Anatomy, Physiology, Surgery, the Practice of Medicine, Obstetrics, Materia Medica, and Chemistry into a single manual; but the operation has signally failed in the hands of all up to the advent of "Neill and Smith's" volume, which is quite a miracle of success. The outlines of the whole are admirably drawn and illustrated, and the authors are eminently entitled to the grateful consideration of the student of every class.—*N. O. Med. and Surg. Journal.*

There are but few students or practitioners of medicine unacquainted with the former editions of this unassuming though highly instructive work. The whole science of medicine appears to have been sifted, as the gold-bearing sands of El Dorado, and the precious facts treasured up in this little volume. A complete portable library so condensed that the student may make it his constant pocket companion.—*Western Lancet.*

In the rapid course of lectures, where work for the students is heavy, and review necessary for an examination, a compend is not only valuable, but it is almost a *sine qua non.* The one before us is, in most of the divisions, the most unexceptionable of all books of the kind that we know of. Of course it is useless for us to recommend it to all last course students, but there is a class to whom we very sincerely commend this cheap book as worth its weight in silver—that class is the graduates in medicine of more than ten years' standing, who have not studied medicine since. They will perhaps find out from it that the science is not exactly now what it was when they left it off.—*The Stethoscope.*

HARTSHORNE (HENRY), M. D.,

Professor of Hygiene in the University of Pennsylvania.

A CONSPECTUS OF THE MEDICAL SCIENCES; containing Handbooks on Anatomy, Physiology, Chemistry, Materia Medica, Practical Medicine, Surgery, and Obstetrics. Second Edition, thoroughly revised and improved. In one large royal 12mo. volume of more than 1000 closely printed pages, with 477 illustrations on wood. Cloth, $4 25; leather, $5 00. (*Just Ready.*)

The favor with which this work has been received has stimulated the author in its revision to render it in every way fitted to meet the wants of the student, or of the practitioner desirous to refresh his acquaintance with the various departments of medical science. The various sections have been brought up to a level with the existing knowledge of the day, while preserving the condensation of form by which so vast an accumulation of facts have been brought within so narrow a compass. The series of illustrations has been much improved, while by the use of a smaller type the additions have been incorporated without increasing unduly the size of the volume.

The work before us has already successfully asserted its claim to the confidence and favor of the profession; it but remains for us to say that in the present edition the whole work has been fully overhauled and brought up to the present status of the science.—*Atlanta Med. and Surg. Journal*, Sept. 1874.

The work is intended as an aid to the medical student, and as such appears to admirably fulfil its object by its excellent arrangement, the full compilation of facts, the perspicuity and terseness of language, and the clear and instructive illustrations in some parts of the work.—*American Journ. of Pharmacy*, Philadelphia, July, 1874.

The volume will be found useful, not only to students, but to many others who may desire to refresh their memories with the smallest possible expenditure of time.—*N. Y. Med. Journal*, Sept. 1874.

The student will find this the most convenient and useful book of the kind on which he can lay his hand.—*Pacific Med. and Surg. Journ.*, Aug. 1874.

LUDLOW (J. L.), M. D.

A MANUAL OF EXAMINATIONS upon Anatomy, Physiology, Surgery, Practice of Medicine, Obstetrics, Materia Medica, Chemistry, Pharmacy, and Therapeutics. To which is added a Medical Formulary. Third edition, thoroughly revised and greatly extended and enlarged. With 370 illustrations. In one handsome royal 12mo. volume of 816 large pages, cloth, $3 25; leather, $3 75.

The arrangement of this volume in the form of question and answer renders it especially suitable for the office examination of students, and for those preparing for graduation.

TANNER (THOMAS HAWKES), M. D., &c.

A MANUAL OF CLINICAL MEDICINE AND PHYSICAL DIAGNOSIS. Third American from the Second London Edition. Revised and Enlarged by TILBURY FOX, M. D., Physician to the Skin Department in University College Hospital, &c. In one neat volume small 12mo., of about 375 pages, cloth, $1 50. (*Just Issued.*)

*** By reference to the "Prospectus of Journal" on page 3, it will be seen that this work is offered as a premium for procuring new subscribers to the "AMERICAN JOURNAL OF THE MEDICAL SCIENCES."

Taken as a whole, it is the most compact vade mecum for the use of the advanced student and junior practitioner with which we are acquainted.—*Boston Med. and Surg. Journal*, Sept. 22, 1870.

It contains so much that is valuable, presented in so attractive a form, that it can hardly be spared even in the presence of more full and complete works. Its convenient size makes it a valuable companion to the country practitioner, and if constantly carried by him, would often render him good service, and relieve many a doubt and perplexity.—*Leavenworth Med Herald* July 1870

The objections commonly, and justly, urged against the general run of "compends," "conspectuses," and other aids to indolence, are not applicable to this little volume, which contains in concise phrase just those practical details that are of most use in daily diagnosis, but which the young practitioner finds it difficult to carry always in his memory without some quickly accessible means of reference. Altogether, the book is one which we can heartily commend to those who have not opportunity for extensive reading, or who, having read much, still wish an occasional practical reminder.—*N. Y. Med. Gazette*, Nov. 10 1870.

GRAY (HENRY), F.R.S.,

Lecturer on Anatomy at St. George's Hospital, London.

ANATOMY, DESCRIPTIVE AND SURGICAL. The Drawings by H. V. CARTER, M. D., late Demonstrator on Anatomy at St. George's Hospital; the Dissections jointly by the AUTHOR and DR. CARTER. A new American, from the fifth enlarged and improved London edition. In one magnificent imperial octavo volume, of nearly 900 pages, with 465 large and elaborate engravings on wood. Price in cloth, $6 00; leather, raised bands, $7 00. (*Just Issued.*)

The author has endeavored in this work to cover a more extended range of subjects than is customary in the ordinary text-books, by giving not only the details necessary for the student, but also the application of those details in the practice of medicine and surgery, thus rendering it both a guide for the learner, and an admirable work of reference for the active practitioner. The engravings form a special feature in the work, many of them being the size of nature, nearly all original, and having the names of the various parts printed on the body of the cut, in place of figures of reference, with descriptions at the foot. They thus form a complete and splendid series, which will greatly assist the student in obtaining a clear idea of Anatomy, and will also serve to refresh the memory of those who may find in the exigencies of practice the necessity of recalling the details of the dissecting room; while combining, as it does, a complete Atlas of Anatomy, with a thorough treatise on systematic, descriptive, and applied Anatomy, the work will be found of essential use to all physicians who receive students in their offices, relieving both preceptor and pupil of much labor in laying the groundwork of a thorough medical education.

Notwithstanding the enlargement of this edition, it has been kept at its former very moderate price, rendering it one of the cheapest works now before the profession.

The illustrations are beautifully executed, and render this work an indispensable adjunct to the library of the surgeon. This remark applies with great force to those surgeons practising at a distance from our large cities, as the opportunity of refreshing their memory by actual dissection is not always attainable.—*Canada Med. Journal*, Aug. 1870.

The work is too well known and appreciated by the profession to need any comment. No medical man can afford to be without it, if its only merit were to serve as a reminder of that which so soon becomes forgotten, when not called into frequent use, viz., the relations and names of the complex organism of the human body. The present edition is much improved. —*California Med. Gazette*, July, 1870.

Gray's Anatomy has been so long the standard of perfection with every student of anatomy, that we need do no more than call attention to the improvement in the present edition.—*Detroit Review of Med. and Pharm.*, Aug. 1870.

From time to time, as successive editions have appeared, we have had much pleasure in expressing the general judgment of the wonderful excellence of Gray's Anatomy.—*Cincinnati Lancet*, July, 1870.

Altogether, it is unquestionably the most complete and serviceable text-book in anatomy that has ever been presented to the student, and forms a striking contrast to the dry and perplexing volumes on the same subject through which their predecessors struggled in days gone by.—*N. Y. Med. Record*, June 15, 1870.

To commend Gray's Anatomy to the medical profession is almost as much a work of supererogation as it would be to give a favorable notice of the Bible in the religious press. To say that it is the most complete and conveniently arranged text-book of its kind, is to repeat what each generation of students has learned as a tradition of the elders, and verified by personal experience.—*N. Y. Med. Gazette*, Dec. 17, 1870.

SMITH (HENRY H.), M.D., and HORNER (WILLIAM E.), M.D.,

Prof. of Surgery in the Univ. of Penna., &c. — *Late Prof. of Anatomy in the Univ. of Penna., &c.*

AN ANATOMICAL ATLAS, illustrative of the Structure of the Human Body. In one volume, large imperial octavo, cloth, with about six hundred and fifty beautiful figures. $4 50.

The plan of this Atlas, which renders it so peculiarly convenient for the student, and its superb artistical execution, have been already pointed out. We must congratulate the student upon the completion of this Atlas, as it is the most convenient work of the kind that has yet appeared; and we must add, the very beautiful manner in which it is "got up," is so creditable to the country as to be flattering to our national pride.—*American Medical Journal.*

SHARPEY (WILLIAM), M.D., and QUAIN (JONES & RICHARD).

HUMAN ANATOMY. Revised, with Notes and Additions, by JOSEPH LEIDY, M.D., Professor of Anatomy in the University of Pennsylvania. Complete in two large octavo volumes, of about 1300 pages, with 511 illustrations; cloth, $6 00.

The very low price of this standard work, and its completeness in all departments of the subject, should command for it a place in the library of all anatomical students.

HODGES (RICHARD M.), M.D.,

Late Demonstrator of Anatomy in the Medical Department of Harvard University.

PRACTICAL DISSECTIONS. Second Edition, thoroughly revised. In one neat royal 12mo. volume, half-bound, $2 00.

The object of this work is to present to the anatomical student a clear and concise description of that which he is expected to observe in an ordinary course of dissections. The author has endeavored to omit unnecessary details, and to present the subject in the form which many years' experience has shown him to be the most convenient and intelligible to the student. In the revision of the present edition, he has sedulously labored to render the volume more worthy of the favor with which it has heretofore been received.

HORNER'S SPECIAL ANATOMY AND HISTOLOGY. Eighth edition, extensively revised and modified. In 2 vols. 8vo., of over 1000 pages, with more than 300 wood-cuts; cloth, $6 00.

WILSON (*ERASMUS*), *F.R.S.*

A SYSTEM OF HUMAN ANATOMY, General and Special. Edited by W. H. GOBRECHT, M. D., Professor of General and Surgical Anatomy in the Medical College of Ohio. Illustrated with three hundred and ninety-seven engravings on wood. In one large and handsome octavo volume, of over 600 large pages; cloth, $4 00; leather, $5 00.

The publisher trusts that the well-earned reputation of this long-established favorite will be more than maintained by the present edition. Besides a very thorough revision by the author, it has been most carefully examined by the editor, and the efforts of both have been directed to introducing everything which increased experience in its use has suggested as desirable to render it a complete text-book for those seeking to obtain or to renew an acquaintance with Human Anatomy. The amount of additions which it has thus received may be estimated from the fact that the present edition contains over one-fourth more matter than the last, rendering a smaller type and an enlarged page requisite to keep the volume within a convenient size. The author has not only thus added largely to the work, but he has also made alterations throughout, wherever there appeared the opportunity of improving the arrangement or style, so as to present every fact in its most appropriate manner, and to render the whole as clear and intelligible as possible. The editor has exercised the utmost caution to obtain entire accuracy in the text, and has largely increased the number of illustrations, of which there are about one hundred and fifty more in this edition than in the last, thus bringing distinctly before the eye of the student everything of interest or importance.

HEATH (*CHRISTOPHER*), *F. R. C. S.*,

Teacher of Operative Surgery in University College, London.

PRACTICAL ANATOMY: A Manual of Dissections. From the Second revised and improved London edition. Edited, with additions, by W. W. KEEN, M. D., Lecturer on Pathological Anatomy in the Jefferson Medical College, Philadelphia. In one handsome royal 12mo. volume of 578 pages, with 247 illustrations. Cloth, $3 50; leather, $4 00. (*Lately Published.*)

Dr. Keen, the American editor of this work, in his preface, says: "In presenting this American edition of 'Heath's Practical Anatomy,' I feel that I have been instrumental in supplying a want long felt for *a real* dissector's manual," and this assertion of its editor we deem is fully justified, after an examination of its contents, for it is really an excellent work. Indeed, we do not hesitate to say, the best of its class with which we are acquainted; resembling Wilson in terse and clear description, excelling most of the so-called practical anatomical dissectors in the scope of the subject and practical selected matter. . . . In reading this work, one is forcibly impressed with the great pains the author takes to impress the subject upon the mind of the student. He is full of rare and pleasing little devices to aid memory in maintaining its hold upon the slippery slopes of anatomy. —*St. Louis Med. and Surg. Journal*, Mar. 10, 1871.

It appears to us certain that, as a guide in dissection, and as a work containing facts of anatomy in brief and easily understood form, this manual is complete. This work contains, also, very perfect illustrations of parts which can thus be more easily understood and studied; in this respect it compares favorably with works of much greater pretension. Such manuals of anatomy are always favorite works with medical students. We would earnestly recommend this one to their attention; it has excellences which make it valuable as a guide in dissecting, as well as in studying anatomy.—*Buffalo Medical and Surgical Journal*, Jan. 1871.

BELLAMY (*E.*), *F.R.C.S.*

THE STUDENT'S GUIDE TO SURGICAL ANATOMY: A Text-Book for Students preparing for their Pass Examination. With engravings on wood. In one handsome royal 12mo. volume. Cloth, $2 25. (*Just Issued.*)

We welcome Mr. Bellamy's work, as a contribution to the study of regional anatomy, of equal value to the student and the surgeon. It is written in a clear and concise style, and its practical suggestions add largely to the interest attaching to its technical details —*Chicago Med. Examiner*, March 1, 1871.

We cordially congratulate Mr. Bellamy upon having produced it.—*Med. Times and Gaz.*

We cannot too highly recommend it.—*Student's Journal.*

Mr. Bellamy has spared no pains to produce a really reliable student's guide to surgical anatomy—one which all candidates for surgical degrees may consult with advantage, and which posseses much original matter.—*Med. Press and Circular.*

MACLISE (*JOSEPH*).

SURGICAL ANATOMY. By JOSEPH MACLISE, Surgeon. In one volume, very large imperial quarto; with 68 large and splendid plates, drawn in the best style and beautifully colored, containing 190 figures, many of them the size of life; together with copious explanatory letter-press. Strongly and handsomely bound in cloth. Price $14 00.

We know of no work on surgical anatomy which can compete with it.—*Lancet.*

The work of Maclise on surgical anatomy is of the highest value. In some respects it is the best publication of its kind we have seen, and is worthy of a place in the library of any medical man, while the student could scarcely make a better investment than this.—*The Western Journal of Medicine and Surgery.*

No such lithographic illustrations of surgical regions have hitherto, we think, been given. While the operator is shown every vessel and nerve where an operation is contemplated, the exact anatomist is refreshed by those clear and distinct dissections, which every one must appreciate who has a particle of enthusiasm. The English medical press has quite exhausted the words of praise, in recommending this admirable treatise.—*Boston Med. and Surg. Journ.*

HARTSHORNE (*HENRY*), *M.D.*,

Professor of Hygiene, etc, in the Univ. of Penna.

HANDBOOK OF ANATOMY AND PHYSIOLOGY. Second Edition, revised. In one royal 12mo. volume, with 220 wood-cuts; cloth, $1 75. (*Now Ready.*)

MARSHALL (*JOHN*), *F. R. S.*,

Professor of Surgery in University College, London, &c.

OUTLINES OF PHYSIOLOGY, HUMAN AND COMPARATIVE.

With Additions by FRANCIS GURNEY SMITH, M. D., Professor of the Institutes of Medicine in the University of Pennsylvania, &c. With numerous illustrations. In one large and handsome octavo volume, of 1026 pages, cloth, $6 50; leather, raised bands, $7 50.

In fact, in every respect, Mr. Marshall has presented us with a most complete, reliable, and scientific work, and we feel that it is worthy our warmest commendation.—*St. Louis Med. Reporter*, Jan. 1869.

We doubt if there is in the English language any compend of physiology more useful to the student than this work.—*St. Louis Med. and Surg. Journal*, Jan. 1869.

It quite fulfils, in our opinion, the author's design of making it truly *educational* in its character—which is, perhaps, the highest commendation that can be asked.—*Am. Journ. Med. Sciences*, Jan. 1869.

We may now congratulate him on having completed the latest as well as the best summary of modern physiological science, both human and comparative, with which we are acquainted. To speak of this work in the terms ordinarily used on such occasions would not be agreeable to ourselves, and would fail to do justice to its author. To write such a book requires a varied and wide range of knowledge, considerable power of analysis, correct judgment, skill in arrangement, and conscientious spirit.—*London Lancet*, Feb. 22, 1868.

There are few, if any, more accomplished anatomists and physiologists than the distinguished professor of surgery at University College; and he has long enjoyed the highest reputation as a teacher of physiology, possessing remarkable powers of clear exposition and graphic illustration. We have rarely the pleasure of being able to recommend a text-book so unreservedly as this.—*British Med. Journal*, Jan. 25, 1868.

CARPENTER (*WILLIAM B.*), *M. D., F. R. S.*,

Examiner in Physiology and Comparative Anatomy in the University of London.

PRINCIPLES OF HUMAN PHYSIOLOGY; with their chief applications to Psychology, Pathology, Therapeutics, Hygiene and Forensic Medicine. A new American from the last and revised London edition. With nearly three hundred illustrations. Edited, with additions, by FRANCIS GURNEY SMITH, M. D., Professor of the Institutes of Medicine in the University of Pennsylvania, &c. In one very large and beautiful octavo volume, of about 900 large pages, handsomely printed; cloth, $5 50; leather, raised bands, $6 50.

With Dr. Smith, we confidently believe "that the present will more than sustain the enviable reputation already attained by former editions, of being one of the fullest and most complete treatises on the subject in the English language." We know of none from the pages of which a satisfactory knowledge of the physiology of the human organism can be as well obtained, none better adapted for the use of such as take up the study of physiology in its reference to the institutes and practice of medicine.—*Am. Jour. Med. Sciences.*

We doubt not it is destined to retain a strong hold on public favor, and remain the favorite text-book in our colleges.—*Virginia Medical Journal.*

The above is the title of what is emphatically *the* great work on physiology; and we are conscious that it would be a useless effort to attempt to add anything to the reputation of this invaluable work, and can only say to all with whom our opinion has any influence, that it is our *authority.—Atlanta Med. Journal.*

BY THE SAME AUTHOR.

PRINCIPLES OF COMPARATIVE PHYSIOLOGY. New American, from the Fourth and Revised London Edition. In one large and handsome octavo volume, with over three hundred beautiful illustrations. Pp. 752. Cloth, $5 00.

As a complete and condensed treatise on its extended and important subject, this work becomes a necessity to students of natural science, while the very low price at which it is offered places it within the reach of all.

KIRKES (*WILLIAM SENHOUSE*), *M.D.*

A MANUAL OF PHYSIOLOGY. Edited by W. MORRANT BAKER, M.D., F.R.C.S. A new American from the eighth and improved London edition. With about two hundred and fifty illustrations. In one large and handsome royal 12mo. volume. Cloth, $3 25; leather, $3 75. (*Just Issued.*)

Kirkes' Physiology has long been known as a concise and exceedingly convenient text-book, presenting within a narrow compass all that is important for the student. The rapidity with which successive editions have followed each other in England has enabled the editor to keep it thoroughly on a level with the changes and new discoveries made in the science, and the eighth edition, of which the present is a reprint, has appeared so recently that it may be regarded as the latest accessible exposition of the subject.

On the whole, there is very little in the book which either the student or practitioner will not find of practical value and consistent with our present knowledge of the rapidly changing science; and we have no hesitation in expressing our opinion that this eighth edition is one of the best handbooks on physiology which we have in our language.—*N. Y. Med. Record*, April 15, 1873.

This volume might well be used to replace many of the physiological text-books in use in this country. It represents more accurately than the works of Dalton or Flint the present state of our knowledge on most physiological questions, while it is much less bulky and far more readable than the larger text-books of Carpenter or Marshall. The book is admirably adapted to be placed in the hands of students.—*Boston Med. and Surg. Journ.*, April 10, 1873.

In its enlarged form it is, in our opinion, still the best book on physiology, most useful to the student. —*Phila. Med. Times*, Aug. 30, 1873.

This is undoubtedly the best work for students of physiology extant.—*Cincinnati Med. News*, Sept. '73.

It more nearly represents the present condition of physiology than any other text-book on the subject.—*Detroit Rev. of Med. Pharm.*, Nov. 1873.

DALTON (J. C.), M. D.,

Professor of Physiology in the College of Physicians and Surgeons, New York, &c.

A TREATISE ON HUMAN PHYSIOLOGY. Designed for the use of Students and Practitioners of Medicine. Fifth edition, revised, with nearly three hundred illustrations on wood. In one very beautiful octavo volume, of over 700 pages, cloth, $5 25; leather, $6 25. (*Lately Issued.*)

Preface to the Fifth Edition.

In preparing the present edition of this work, the general plan and arrangement of the previous editions have been retained, so far as they have been found useful and adapted to the purposes of a text-book for students of medicine. The incessant advance of all the natural and physical sciences, never more active than within the last five years, has furnished many valuable aids to the special investigations of the physiologist; and the progress of physiological research, during the same period, has required a careful revision of the entire work, and the modification or rearrangement of many of its parts. At this day, nothing is regarded as of any value in natural science which is not based upon direct and intelligible observation or experiment; and, accordingly, the discussion of doubtful or theoretical questions has been avoided, as a general rule, in the present volume, while new facts, from whatever source, if fully established, have been added and incorporated with the results of previous investigation. A number of new illustrations have been introduced, and a few of the older ones, which seemed to be no longer useful, have been omitted. In all the changes and additions thus made, it has been the aim of the writer to make the book, in its present form, a faithful exponent of the actual conditions of physiological science.

NEW YORK, October, 1871.

In this, the standard text-book on Physiology, all that is needed to maintain the favor with which it is regarded by the profession, is the author's assurance that it has been thoroughly revised and brought up to a level with the advanced science of the day. To accomplish this has required some enlargement of the work, but no advance has been made in the price.

The fifth edition of this truly valuable work on Human Physiology comes to us with many valuable improvements and additions. As a text-book of physiology the work of Prof. Dalton has long been well known as one of the best which could be placed in the hands of student or practitioner. Prof. Dalton has, in the several editions of his work heretofore published, labored to keep step with the advancement in science, and the last edition shows by its improvements on former ones that he is determined to maintain the high standard of his work. We predict for the present edition increased favor, though this work has long been the favorite standard.—*Buffalo Med. and Surg. Journal*, April, 1872.

An extended notice of a work so generally and favorably known as this is unnecessary. It is justly regarded as one of the most valuable text-books on the subject in the English language.—*St. Louis Med. Archives*, May, 1872.

We know no treatise in physiology so clear, complete, well assimilated, and perfectly digested, as Dalton's. He never writes cloudily or dubiously, or in mere quotation. He assimilates all his material, and from it constructs a homogeneous transparent argument, which is always honest and well informed, and hides neither truth, ignorance, nor doubt, so far as either belongs to the subject in hand.—*Brit. Med. Journal*, March 23, 1872.

Dr. Dalton's treatise is well known, and by many highly esteemed in this country. It is, indeed, a good elementary treatise on the subject it professes to teach, and may safely be put into the hands of English students. It has one great merit—it is clear, and, on the whole, admirably illustrated. The part we have always esteemed most highly is that relating to Embryology. The diagrams given of the various stages of development give a clearer view of the subject than do those in general use in this country; and the text may be said to be, upon the whole, equally clear.—*London Med. Times and Gazette*, March 23, 1872.

Dalton's Physiology is already, and deservedly, the favorite text-book of the majority of American medical students. Treating a most interesting department of science in his own peculiarly lively and fascinating style, Dr. Dalton carries his reader along without effort, and at the same time impresses upon his mind the truths taught much more successfully than if they were buried beneath a multitude of words.—*Kansas City Med. Journal*, April, 1872.

Professor Dalton is regarded justly as *the* authority in this country on physiological subjects, and the fifth edition of his valuable work fully justifies the exalted opinion the medical world has of his labors. This last edition is greatly enlarged.—*Virginia Clinical Record*, April, 1872.

DUNGLISON (ROBLEY), M. D.,

Professor of Institutes of Medicine in Jefferson Medical College, Philadelphia.

HUMAN PHYSIOLOGY. Eighth edition. Thoroughly revised and extensively modified and enlarged, with five hundred and thirty-two illustrations. In two large and handsomely printed octavo volumes of about 1500 pages, cloth, $7 00.

LEHMANN (C. G.).

PHYSIOLOGICAL CHEMISTRY. Translated from the second edition by GEORGE E. DAY, M. D., F. R. S., &c., edited by R. E. ROGERS, M. D., Professor of Chemistry in the Medical Department of the University of Pennsylvania, with illustrations selected from Funke's Atlas of Physiological Chemistry, and an Appendix of plates. Complete in two large and handsome octavo volumes, containing 1200 pages, with nearly two hundred illustrations, cloth, $6 00.

BY THE SAME AUTHOR.

MANUAL OF CHEMICAL PHYSIOLOGY. Translated from the German, with Notes and Additions, by J. CHESTON MORRIS, M. D., with an Introductory Essay on Vital Force, by Professor SAMUEL JACKSON, M. D., of the University of Pennsylvania. With illustrations on wood. In one very handsome octavo volume of 336 pages, cloth, $2 25.

ATTFIELD (JOHN), *Ph. D.*,

Professor of Practical Chemistry to the Pharmaceutical Society of Great Britain, &c.

CHEMISTRY, GENERAL, MEDICAL, AND PHARMACEUTICAL;

including the Chemistry of the U. S. Pharmacopœia. A Manual of the General Principles of the Science, and their Application to Medicine and Pharmacy. Fifth Edition, revised by the author. In one handsome royal 12mo. volume; cloth, $2 75; leather, $3 25. (*Just Issued.*)

No other American publication with which we are acquainted covers the same ground, or does it so well. In addition to an admirable exposé of the facts and principles of general elementary chemistry, the author has presented us with a condensed mass of practical matter, just such as the medical student and practitioner needs.—*Cincinnati Lancet*, Mar. 1874.

We commend the work heartily as one of the best text-books extant for the medical student.—*Detroit Rev. of Med. and Pharm.*, Feb. 1872.

The best work of the kind in the English language. —*N. Y. Psychological Journal*, Jan. 1872.

The work is constructed with direct reference to the wants of medical and pharmacentical students; and, although an English work, the points of difference between the British and United States Pharmacopœias are indicated, making it as useful here as in England. Altogether, the book is one we can heartily recommend to practitioners as well as students. —*N. Y. Med. Journal*, Dec. 1871.

It differs from other text-books in the following particulars: first, in the exclusion of matter relating to compounds which, at present, are only of interest to the scientific chemist; secondly, in containing the chemistry of every substance recognized officially or in general, as a remedial agent. It will be found a most valuable book for pupils, assistants, and others engaged in medicine and pharmacy, and we heartily commend it to our readers.—*Canada Lancet*, Oct. 1871.

When the original English edition of this work was published, we had occasion to express our high appreciation of its worth, and also to review, in considerable detail, the main features of the book. As the arrangement of subjects, and the main part of the text of the present edition are similar to the former publication, it will be needless for us to go over the ground a second time; we may, however, call attention to a marked advantage possessed by the American work—we allude to the introduction of the chemistry of the preparations of the United States Pharmacopœia, as well as that relating to the British authority. — *Canadian Pharmaceutical Journal*, Nov. 1871.

Chemistry has borne the name of being a hard subject to master by the student of medicine, and chiefly because so much of it consists of compounds only of interest to the scientific chemist; in this work such portions are modified or altogether left out, and in the arrangement of the subject-matter of the work, practical utility is sought after, and we think fully attained. We commend it for its clearness and order to both teacher and pupil.—*Oregon Med. and Surg. Reporter*, Oct. 1871.

FOWNES (GEORGE), *Ph. D.*

A MANUAL OF ELEMENTARY CHEMISTRY; Theoretical and Practical.

With one hundred and ninety-seven illustrations. A new American, from the tenth and revised London edition. Edited by ROBERT BRIDGES, M. D. In one large royal 12mo. volume, of about 850 pp., cloth, $2 75; leather, $3 25. (*Lately Issued.*)

This work is so well known that it seems almost superfluous for us to speak about it. It has been a favorite text-book with medical students for years, and its popularity has in no respect diminished. Whenever we have been consulted by medical students, as has frequently occurred, what treatise on chemistry they should procure, we have always recommended Fownes', for we regarded it as the best. There is no work that combines so many excellences. It is of convenient size, not prolix, of plain perspicuous diction, contains all the most recent discoveries, and is of moderate price.—*Cincinnati Med. Repertory*, Aug. 1869.

Large additions have been made, especially in the department of organic chemistry, and we know of no other work that has greater claims on the physician, pharmaceutist, or student, than this. We cheerfully recommend it as the best text-book on elementary chemistry, and bespeak for it the careful attention of students of pharmacy.—*Chicago Pharmacist*, Aug. 1869.

Here is a new edition which has been long watched for by eager teachers of chemistry. In its new garb, and under the editorship of Mr. Watts, it has resumed its old place as the most successful of text-books.—*Indian Medical Gazette*, Jan. 1, 1869

It will continue, as heretofore, to hold the first rank as a text-book for students of medicine.—*Chicago Med. Examiner*, Aug. 1869.

ODLING (WILLIAM),

Lecturer on Chemistry at St. Bartholomew's Hospital, &c.

A COURSE OF PRACTICAL CHEMISTRY, arranged for the Use of Medical Students.

With Illustrations. From the Fourth and Revised London Edition. In one neat royal 12mo. volume, cloth, $2. (*Lately Issued.*)

GALLOWAY (ROBERT), *F.C.S.*,

Prof. of Applied Chemistry in the Royal College of Science for Ireland, &c.

A MANUAL OF QUALITATIVE ANALYSIS.

From the Fifth London Edition. In one neat royal 12mo. volume, with illustrations; cloth, $2 50. (*Just Issued.*)

The success which has carried this work through repeated editions in England, and its adoption as a text-book in several of the leading institutions in this country, show that the author has succeeded in the endeavor to produce a sound practical manual and book of reference for the chemical student.

Prof. Galloway's books are deservedly in high esteem, and this American reprint of the fifth edition of his Manual of Qualitative Analysis, will be acceptable to many American students to whom the English edition is not accessible.—*Am. Jour. of Science and Arts*, Sept. 1872.

We regard this volume as a valuable addition to the chemical text-books, and as particularly calculated to instruct the student in analytical researches of the inorganic compounds, the important vegetable acids, and of compounds and various secretions and excretions of animal origin.—*Am. Journ. of Pharm.*, Sept. 1872.

BLOXAM (C. L.),
Professor of Chemistry in King's College, London.

CHEMISTRY, INORGANIC AND ORGANIC. From the Second London Edition. In one very handsome octavo volume, of 700 pages, with about 300 illustrations. Cloth, $4 00; leather, $5 00. (*Just Issued.*)

It has been the author's endeavor to produce a Treatise on Chemistry sufficiently comprehensive for those studying the science as a branch of general education, and one which a student may use with advantage in pursuing his chemical studies at one of the colleges or medical schools. The special attention devoted to Metallurgy and some other branches of Applied Chemistry renders the work especially useful to those who are being educated for employment in manufacture.

We have in this work a complete and most excellent text-book for the use of schools, and can heartily recommend it as such.—*Boston Med. and Surg. Journ.*, May 28, 1874.

Of all the numerous works upon elementary chemistry that have been published within the last few years, we can point to none that, in fulness, accuracy, and simplicity, can surpass this; while, in the number and detailed descriptions of experiments, as also in the profuseness of its illustrations, we believe it stands above any similar work published in this country. . . . . The statements made are clear and concise, and every step proved by an abundance of experiments, which excite our admiration as much by their simplicity as by their direct conclusiveness.—*Chicago Med. Examiner*, Nov. 15, 1873.

It is seldom that in the same compass so complete and interesting a compendium of the leading facts of chemistry is offered.—*Druggists' Circular*, Nov. '73.

The above is the title of a work which we can most conscientiously recommend to students of chemistry. It is as easy as a work on chemistry could be made, at the same time that it presents a full account of that science as it now stands. We have spoken of the work as admirably adapted to the wants of students; it is quite as well suited to the requirements of practitioners who wish to review their chemistry, or have occasion to refresh their memories on any point relating to it. In a word, it is a book to be read by all who wish to know what is the chemistry of the present day.—*American Practitioner*, Nov. 1873.

Among the various works upon general chemistry issued, we know of none that will supply the average wants of the student or teacher better than this.—*Indiana Journ. of Med.*, Nov. 1873.

We cordially welcome this American reprint of a work which has already won for itself so substantial a reputation in England. Professor Bloxam has condensed into a wonderfully small compass all the important principles and facts of chemical science. Thoroughly imbued with an enthusiastic love for the science he expounds, he has stripped it of all needless technicalities, and rounded out its hard outlines by a fulness of illustration that cannot fail to attract and delight the student. The details of illustrative experiment have been worked up with especial care, and many of the experiments described are both new and striking.—*Detroit Rev. of Med. and Pharm.*, Nov. 1873.

One of the best text-books of chemistry yet published.—*Chicago Med. Journ.*, Nov. 1873.

This is an excellent work, well adapted for the beginner and the advanced student of chemistry.—*Am. Journ. of Pharm.*, Nov. 1873.

Probably the most valuable, and at the same time practical, text-book on general chemistry extant in our language.—*Kansas City Med. Journ.*, Dec. 1873.

Prof. Bloxam possesses pre-eminently the inestimable gift of perspicuity. It is a pleasure to read his books, for he is capable of making very plain what other authors frequently have left very obscure.—*Va. Clinical Record*, Nov. 1873.

It would be difficult for a practical chemist and teacher to find any material fault with this most admirable treatise. The author has given us almost a cyclopedia within the limits of a convenient volume, and has done so without penning the *useless* paragraphs too commonly making up a great part of the bulk of many cumbrous works. The progressive scientist is not disappointed when he looks for the record of new and valuable processes and discoveries, while the cautious conservative does not find its pages monopolized by uncertain theories and speculations. A peculiar point of excellence is the crystallized form of expression in which great truths are expressed in very short paragraphs. One is surprised at the brief space allotted to an important topic, and yet, after reading it, he feels that little, if any more, should have been said. Altogether, it is seldom you see a text-book so nearly faultless.—*Cincinnati Lancet*, Nov. 1873.

Professor Bloxam has given us a most excellent and useful practical treatise. His 666 pages are crowded with facts and experiments, nearly all well chosen, and many quite new, even to scientific men. . . . It is astonishing how much information he often conveys in a few paragraphs. We might quote fifty instances of this.—*Chemical News.*

WÖHLER AND FITTIG.

OUTLINES OF ORGANIC CHEMISTRY. Translated with Additions from the Eighth German Edition. By IRA REMSEN, M.D., Ph.D., Professor of Chemistry and Physics in Williams College, Mass. In one handsome volume, royal 12mo. of 550 pp., cloth, $3. (*Just Issued.*)

As the numerous editions of the original attest, this work is the leading text-book and standard authority throughout Germany on its important and intricate subject—a position won for it by the clearness and conciseness which are its distinguishing characteristics. The translation has been executed with the approbation of Profs. Wöhler and Fittig, and numerous additions and alterations have been introduced, so as to render it in every respect on a level with the most advanced condition of the science.

BOWMAN (JOHN E.), M. D.

PRACTICAL HANDBOOK OF MEDICAL CHEMISTRY. Edited by C. L. BLOXAM, Professor of Practical Chemistry in King's College, London. Sixth American, from the fourth and revised English Edition. In one neat volume, royal 12mo., pp. 351, with numerous illustrations, cloth, $2 25.

BY THE SAME AUTHOR. (*Now Ready.*)

INTRODUCTION TO PRACTICAL CHEMISTRY, INCLUDING ANALYSIS. Sixth American, from the sixth and revised London edition. With numerous illustrations. In one neat vol., royal 12mo., cloth, $2 25.

KNAPP'S TECHNOLOGY; or Chemistry Applied to the Arts, and to Manufactures. With American additions, by Prof. WALTER R. JOHNSON. In two very handsome octavo volumes, with 500 wood engravings, cloth, $6 00

PARRISH (EDWARD),

Late Professor of Materia Medica in the Philadelphia College of Pharmacy.

A TREATISE ON PHARMACY. Designed as a Text-Book for the Student, and as a Guide for the Physician and Pharmaceutist. With many Formulæ and Prescriptions. Fourth Edition, thoroughly revised, by THOMAS S. WIEGAND. In one handsome octavo volume of 977 pages, with 280 illustrations; cloth, $5 50; leather, $6 50. (*Now Ready.*)

The delay in the appearance of the new U. S. Pharmacopœia, and the sudden death of the author, have postponed the preparation of this new edition beyond the period expected. The notes and memoranda left by Mr. Parrish have been placed in the hands of the editor, Mr. Wiegand, who has labored assiduously to embody in the work all the improvements of pharmaceutical science which have been introduced during the last ten years. It is therefore hoped that the new edition will fully maintain the reputation which the volume has heretofore enjoyed as a standard text-book and work of reference for all engaged in the preparation and dispensing of medicines.

We have examined this large volume with a good deal of care, and find that the author has completely exhausted the subject upon which he treats; a more complete work, we think, it would be impossible to find. To the student of pharmacy the work is indispensable; indeed, so far as we know, it is the only one of its kind in existence, and even to the physician or medical student who can spare five dollars to purchase it, we feel sure the practical information he will obtain will more than compensate him for the outlay.—*Canada Med. Journal*, Nov. 1864.

The medical student and the practising physician will find the volume of inestimable worth for study and reference.—*San Francisco Med. Press*, July, 1864.

When we say that this book is in some respects the best which has been published on the subject in the English language for a great many years, we do not wish it to be understood as very extravagant praise. In truth, it is not so much the best as the only book.—*The London Chemical News.*

An attempt to furnish anything like an analysis of Parrish's very valuable and elaborate *Treatise on Practical Pharmacy* would require more space than we have at our disposal. This, however, is not so much a matter of regret, inasmuch as it would be difficult to think of any point, however minute and apparently trivial, connected with the manipulation of pharmaceutic substances or appliances which has not been clearly and carefully discussed in this volume. Want of space prevents our enlarging further on this valuable work, and we must conclude by a simple expression of our hearty appreciation of its merits.—*Dublin Quarterly Jour. of Medical Science*, August, 1864.

STILLÉ (ALFRED), M.D.,

Professor of Theory and Practice of Medicine in the University of Penna.

THERAPEUTICS AND MATERIA MEDICA; a Systematic Treatise on the Action and Uses of Medicinal Agents, including their Description and History Fourth edit., revised and enlarged. In two large and handsome 8vo. vols. (*Nearly Ready.*)

Dr. Stillé's splendid work on therapeutics and materia medica.—*London Med. Times*, April 8, 1865.

Dr. Stillé stands to-day one of the best and most honored representatives at home and abroad, of American medicine; and these volumes, a library in themselves, a treasure-house for every studious physician, assure his fame even had he done nothing more.—*The Western Journal of Medicine*, Dec. 1868.

We regard this work as the best one on Materia Medica in the English language, and as such it deserves the favor it has received.—*Am. Journ. Medical Sciences*, July 1868.

We need not dwell on the merits of the third edition of this magnificently conceived work. It is the work on Materia Medica, in which Therapeutics are primarily considered—the mere natural history of drugs being briefly disposed of. To medical practitioners this is a very valuable conception. It is wonderful how much of the riches of the literature of Materia Medica has been condensed into this book. The references alone would make it worth possessing. But it is not a mere compilation. The writer exercises a good judgment of his own on the great doctrines and points of Therapeutics For purposes of practice, Stillé's book is almost unique as a repertory of information, empirical and scientific, on the actions and uses of medicines.—*London Lancet*, Oct. 31, 1868.

Through the former editions, the professional world is well acquainted with this work. At home and abroad its reputation as a standard treatise on Materia Medica is securely established. It is second to no work on the subject in the English tongue, and, indeed, is decidedly superior, in some respects, to any other.—*Pacific Med. and Surg. Journal*, July, 1868.

Stillé's Therapeutics is incomparably the best work on the subject.—*N. Y. Med. Gazette*, Sept. 26, 1868.

Dr. Stillé's work is becoming the best known of any of our treatises on Materia Medica. . . . One of the most valuable works in the language on the subjects of which it treats.—*N. Y. Med. Journal*, Oct. 1868.

The rapid exhaustion of two editions of Prof. Stillé's scholarly work, and the consequent necessity for a third edition, is sufficient evidence of the high estimate placed upon it by the profession. It is no exaggeration to say that there is no superior work upon the subject in the English language. The present edition is fully up to the most recent advance in the science and art of therapeutics.—*Leavenworth Medical Herald*, Aug. 1868.

The work of Prof. Stillé has rapidly taken a high place in professional esteem, and to say that a third edition is demanded and now appears before us, sufficiently attests the firm position this treatise has made for itself. As a work of great research, and scholarship, it is safe to say we have nothing superior. It is exceedingly full, and the busy practitioner will find ample suggestions upon almost every important point of therapeutics.—*Cincinnati Lancet*, Aug. 1868.

PEREIRA (JONATHAN), M.D., F.R.S. and L.S.

MATERIA MEDICA AND THERAPEUTICS; being an Abridgment of the late Dr. Pereira's Elements of Materia Medica, arranged in conformity with the British Pharmacopœia, and adapted to the use of Medical Practitioners, Chemists and Druggists, Medical and Pharmaceutical Students, &c. By F. J. FARRE, M.D., Senior Physician to St. Bartholomew's Hospital, and London Editor of the British Pharmacopœia; assisted by ROBERT BENTLEY, M.R.C.S., Professor of Materia Medica and Botany to the Pharmaceutical Society of Great Britain; and by ROBERT WARINGTON, F.R.S., Chemical Operator to the Society of Apothecaries. With numerous additions and references to the United States Pharmacopœia, by HORATIO C. WOOD, M.D., Professor of Botany in the University of Pennsylvania. In one large and handsome octavo volume of 1040 closely printed pages, with 236 illustrations, cloth, $7 00; leather, raised bands, $8 00.

It will fill a place which no other work can occupy in the library of the physician, student, and apothecary.—*Boston Med. and Surg. Journal*, Nov. 8, 1866.

The American physician now has all that is needed in the shape of a complete treatise on materia medica, and the medical student has a text-book which, for practical utility and intrinsic worth, stands unparalleled.—*N. Y. Med. Record*, Nov. 15, 1866.

GRIFFITH (ROBERT E.), M.D.

A UNIVERSAL FORMULARY, Containing the Methods of Preparing and Administering Officinal and other Medicines. The whole adapted to Physician and Pharmaceutists. Third edition, thoroughly revised, with numerous additions, by JOHN M. MAISCH, Professor of Materia Medica in the Philadelphia College of Pharmacy. In one large and handsome octavo volume of about 800 pages, cloth, $4 50; leather, $5 50. (*Just Ready.*)

This work has long been known for the vast amount of information which it presents in a condensed form, arranged for easy reference. The new edition has received the most careful revision at the competent hands of Professor Maisch, who has brought the whole up to the standard of the most recent authorities. More than eighty new headings of remedies have been introduced, the entire work has been thoroughly remodelled, and whatever has seemed to be obsolete has been omitted. As a comparative view of the United States, the British, the German, and the French Pharmacopœias, together with an immense amount of unofficinal formulas, it affords to the practitioner and pharmaceutist an aid in their daily avocations not to be found elsewhere, while three indexes, one of "Diseases and their Remedies," one of Pharmaceutical Names, and a General Index, afford an easy key to the alphabetical arrangement adopted in the text.

The young practitioner will find the work invaluable in suggesting eligible modes of administering many remedies.—*Am. Journ. of Pharm.*, Feb. 1874.

Our copy of Griffith's Formulary, after long use, first in the dispensing shop, and afterwards in our medical practice, had gradually fallen behind in the onward march of materia medica, pharmacy, and therapeutics, until we had ceased to consult it as a daily book of reference. So completely has Prof. Maisch reformed, remodelled, and rejuvenated it in the new edition, we shall gladly welcome it back to our table again beside Dunglison, Webster, and Wood & Bache. The publisher could not have been more fortunate in the selection of an editor. Prof. Maisch is eminently the man for the work, and he has done it thoroughly and ably. To enumerate the alterations, amendments, and additions would be an endless task; everywhere we are greeted with the evidences of his labor. Following the Formulary, is an addendum of useful Recipes, Dietetic Preparations, List of Incompatibles, Posological table, table of Pharmaceutical Names, Officinal Preparations and Directions, Poisons, Antidotes and Treatment, and copious indices, which afford ready access to all parts of the work. We unhesitatingly commend the book as being the best of its kind, within our knowledge. —*Atlanta Med. and Surg. Journ.*, Feb. 1874.

To the druggist a good formulary is simply indispensable, and perhaps no formulary has been more extensively used than the well-known work before us. Many physicians have to officiate, also, as druggists. This is true especially of the country physician, and a work which shall teach him the means by which to administer or combine his remedies in the most efficacious and pleasant manner, will always hold its place upon his shelf. A formulary of this kind is of benefit also to the city physician in largest practice.—*Cincinnati Clinic*, Feb. 21, 1874.

The Formulary has already proved itself acceptable to the medical profession, and we do not hesitate to say that the third edition is much improved, and of greater practical value, in consequence of the careful revision of Prof Maisch.—*Chicago Med. Examiner*, March 15, 1874.

ELLIS (BENJAMIN), M.D.

THE MEDICAL FORMULARY: being a Collection of Prescriptions derived from the writings and practice of many of the most eminent physicians of America and Europe. Together with the usual Dietetic Preparations and Antidotes for Poisons. The whole accompanied with a few brief Pharmaceutic and Medical Observations. Twelfth edition, carefully revised and much improved by ALBERT H. SMITH, M. D. In one volume 8vo. of 376 pages, cloth, $3 00. (*Lately Published.*)

This work has remained for some time out of print, owing to the anxious care with which the Editor has sought to render the present edition worthy a continuance of the very remarkable favor which has carried the volume to the unusual honor of a TWELFTH EDITION. He has sedulously endeavored to introduce in it all new preparations and combinations deserving of confidence, besides adding two new classes, Antemetics and Disinfectants, with brief references to the inhalation of atomized fluids, the nasal douche of Thudichum, suggestions upon the method of hypodermic injection, the administration of anæsthetics, &c. &c. To accommodate these numerous additions, he has omitted much which the advance of science has rendered obsolete or of minor importance, notwithstanding which the volume has been increased by more than thirty pages. A new feature will be found in a copious Index of Diseases and their remedies, which cannot but increase the value of the work as a suggestive book of reference for the working practitioner. Every precaution has been taken to secure the typographical accuracy so necessary in a work of this nature, and it is hoped that the new edition will fully maintain the position which "ELLIS' FORMULARY" has long occupied.

CARSON (JOSEPH), M.D.,

Professor of Materia Medica and Pharmacy in the University of Pennsylvania, &c.

SYNOPSIS OF THE COURSE OF LECTURES ON MATERIA MEDICA AND PHARMACY, delivered in the University of Pennsylvania. With three Lectures on the Modus Operandi of Medicines. Fourth and revised edition, cloth, $3.

DUNGLISON'S NEW REMEDIES, WITH FORMULÆ FOR THEIR PREPARATION AND ADMINISTRATION. Seventh edition, with extensive additions. One vol. 8vo., pp. 770; cloth. $4 00.

ROYLE'S MATERIA MEDICA AND THERAPEUTICS. Edited by JOSEPH CARSON, M. D. With ninety-eight illustrations. 1 vol. 8vo., pp. 700, cloth. $3 00.

CHRISTISON'S DISPENSATORY. With copious additions, and 213 large wood-engravings. By R. EGLESFELD GRIFFITH, M.D. One vol. 8vo., pp. 1000; cloth. $4 00.

CARPENTER'S PRIZE ESSAY ON THE USE OF ALCOHOLIC LIQUORS IN HEALTH AND DISEASE. New edition, with a Preface by D. F. CONDIE, M.D., and explanations of scientific words. In one neat 12mo. volume, pp. 178, cloth. 60 cents.

DE JONGH ON THE THREE KINDS OF COD-LIVER OIL, with their Chemical and Therapeutic Properties 1 vol. 12mo., cloth. 75 cents.

FENWICK (SAMUEL), M.D.,
Assistant Physician to the London Hospital.

THE STUDENT'S GUIDE TO MEDICAL DIAGNOSIS. From the Third Revised and Enlarged English Edition. With eighty-four illustrations on wood. In one very handsome volume, royal 12mo., cloth, $2 25. (*Just Issued.*)

The very great success which this work has obtained in England, shows that it has supplied an admitted want among elementary books for the guidance of students and junior practitioners. Taking up in order each portion of the body or class of disease, the author has endeavored to present in simple language the value of symptoms, so as to lead the student to a correct appreciation of the pathological changes indicated by them. The latest investigations have been carefully introduced into the present edition, so that it may fairly be considered as on a level with the most advanced condition of medical science.

Of the many guide-books on medical diagnosis, claimed to be written for the special instruction of students, this is the best. The author is evidently a well-read and accomplished physician, and he knows how to teach practical medicine. The charm of simplicity is not the least interesting feature in the manner in which Dr. Fenwick conveys instruction. There are few books of this size on practical medicine that contain so much and convey it so well as the volume before us. It is a book we can sincerely recommend to the student for direct instruction, and to the practitioner as a ready and useful aid to his memory.—*Am. Journ. of Syphilography*, Jan. 1874.

It covers the ground of medical diagnosis in a concise, practical manner, well calculated to assist the student in forming a correct, thorough, and systematic method of examination and diagnosis of disease. The illustrations are numerous, and finely executed. Those illustrative of the microscopic appearance of morbid tissue, &c., are especially clear and distinct. —*Chicago Med. Examiner*, Nov. 1873.

So far superior to any offered to students that the colleges of this country should recommend it to their respective classes.—*N. O. Med. and Surg. Journ.*, March, 1874.

This little book ought to be in the possession of every medical student.—*Boston Medical and Surg. Journ.*, Jan. 15, 1874.

GREEN (T. HENRY), M.D.,
Lecturer on Pathology and Morbid Anatomy at Charing-Cross Hospital Medical School.

PATHOLOGY AND MORBID ANATOMY. With numerous Illustrations on Wood. In one very handsome octavo volume of over 250 pages, cloth, $2 50. (*Lately Published.*)

We have been very much pleased by our perusal of this little volume. It is the only one of the kind with which we are acquainted, and practitioners as well as students will find it a very useful guide; for the information is up to the day, well and compactly arranged, without being at all scanty.—*London Lancet*, Oct. 7, 1871.

It embodies in a comparatively small space a clear statement of the present state of our knowledge of pathology and morbid anatomy. The author shows that he has been not only a student of the teachings of his *confrères* in this branch of science, but a practical and conscientious laborer in the post-mortem chamber. The work will prove a useful one to the great mass of students and practitioners whose time for devotion to this class of studies is limited.—*Am. Journ. of Syphilography*, April, 1872.

GLUGE'S ATLAS OF PATHOLOGICAL HISTOLOGY. Translated, with Notes and Additions, by JOSEPH LEIDY, M. D. In one volume, very large imperial quarto, with 320 copper-plate figures, plain and colored, cloth. $4 00.

JONES AND SIEVEKING'S PATHOLOGICAL ANATOMY. With 397 wood-cuts. 1 vol. 8vo., of nearly 750 pages, cloth. $3 50.

HOLLAND'S MEDICAL NOTES AND REFLECTIONS. 1 vol. 8vo., pp. 500, cloth. $3 50

WHAT TO OBSERVE AT THE BEDSIDE AND AFTER DEATH IN MEDICAL CASES. Published under the authority of the London Society for Medical Observation. From the second London edition. 1 vol. royal 12mo., cloth. $1 00.

LA ROCHE ON YELLOW FEVER, considered in its Historical, Pathological, Etiological, and Therapeutical Relations. In two large and handsome octavo volumes of nearly 1500 pages, cloth. $7 00.

LAYCOCK'S LECTURES ON THE PRINCIPLES AND METHODS OF MEDICAL OBSERVATION AND RESEARCH. For the use of advanced students and junior practitioners. In one very neat royal 12mo. volume, cloth. $1 00.

BARLOW'S MANUAL OF THE PRACTICE OF MEDICINE. With Additions by D. F. CONDIE, M. D. 1 vol. 8vo., pp. 600, cloth. $2 50.

TODD'S CLINICAL LECTURES ON CERTAIN ACUTE DISEASES. In one neat octavo volume, of 320 pages, cloth. $2 50.

STURGES (OCTAVIUS), M.D. Cantab.,
Fellow of the Royal College of Physicians, &c. &c.

AN INTRODUCTION TO THE STUDY OF CLINICAL MEDICINE. Being a Guide to the Investigation of Disease, for the Use of Students. In one handsome 12mo. volume, cloth, $1 25. (*Just Issued.*)

DAVIS (NATHAN S.),
Prof. of Principles and Practice of Medicine, etc., in Chicago Med. College.

CLINICAL LECTURES ON VARIOUS IMPORTANT DISEASES; being a collection of the Clinical Lectures delivered in the Medical Wards of Mercy Hospital, Chicago. Edited by FRANK H. DAVIS, M.D. Second edition, enlarged. In one handsome royal 12mo. volume. (*Nearly Ready.*)

STOKES (WILLIAM), M.D., D.C.L., F.R.S.,
Regius Professor of Physic in the Univ. of Dublin, &c.

LECTURES ON FEVER, delivered in the Theatre of the Meath Hospital and County of Dublin Infirmary. Edited by JOHN WILLIAM MOORE, M.D., Assistant Physician to the Cork Street Fever Hospital. In one neat octavo volume. (*Preparing.*)

*** To appear in the "MEDICAL NEWS AND LIBRARY" for 1875.

FLINT (AUSTIN), M.D.,

Professor of the Principles and Practice of Medicine in Bellevue Med. College, N. Y

A TREATISE ON THE PRINCIPLES AND PRACTICE OF MEDICINE; designed for the use of Students and Practitioners of Medicine. Fourth edition, revised and enlarged. In one large and closely printed octavo volume of about 1100 pages; cloth, $6 00; or strongly bound in leather, with raised bands, $7 00. (*Just Issued.*)

By common consent of the English and American medical press, this work has been assigned to the highest position as a complete and compendious text-book on the most advanced condition of medical science. At the very moderate price at which it is offered it will be found one of the cheapest volumes now before the profession. A few notices of previous editions are subjoined.

Admirable and unequalled.—*Western Journal of Medicine*, Nov. 1869.

Dr. Flint's work, though claiming no higher title than that of a text-book, is really more. He is a man of large clinical experience, and his book is full of such masterly descriptions of disease as can only be drawn by a man intimately acquainted with their various forms. It is not so long since we had the pleasure of reviewing his first edition, and we recognize a great improvement, especially in the general part of the work. It is a work which we can cordially recommend to our readers as fully abreast of the science of the day.—*Edinburgh Med. Journal*, Oct. '69.

One of the best works of the kind for the practitioner, and the most convenient of all for the student. —*Am. Journ. Med. Sciences*, Jan. 1869.

This work, which stands pre-eminently as the advance standard of medical science up to the present time in the practice of medicine, has for its author one who is well and widely known as one of the leading practitioners of this continent. In fact, it is seldom that any work is ever issued from the press more deserving of universal recommendation.—*Dominion Med Journal*, May, 1869.

The third edition of this most excellent book scarcely needs any commendation from us. The volume, as it stands now, is really a marvel: first of all, it is excellently printed and bound—and we encounter that luxury of America, the ready-cut pages, which the Yankees are 'cute enough to insist upon—nor are these by any means trifles; but the contents of the book are astonishing. Not only is it wonderful that any one man can have grasped in his mind the whole scope of medicine with that vigor which Dr. Flint shows, but the condensed yet clear way in which this is done is a perfect literary triumph. Dr. Flint is pre-eminently one of the strong men, whose right to do this kind of thing is well admitted; and we say no more than the truth when we affirm that he is very nearly the only living man that could do it with such results as the volume before us.—*The London Practitioner*, March, 1869.

This is in some respects the best text-book of medicine in our language, and it is highly appreciated on the other side of the Atlantic, inasmuch as the first edition was exhausted in a few months. The second edition was little more than a reprint, but the present has, as the author says, been thoroughly revised. Much valuable matter has been added, and by making the type smaller, the bulk of the volume is not much increased. The weak point in many American works is pathology, but Dr. Flint has taken peculiar pains on this point, greatly to the value of the book. —*London Med. Times and Gazette*, Feb. 6, 1869.

BY THE SAME AUTHOR. (*Shortly.*)

ESSAYS ON CONSERVATIVE MEDICINE AND KINDRED TOPICS. In one very handsome royal 12mo. volume. Cloth, $1 38. (*Now Ready.*)

CONTENTS.

I. Conservative Medicine. II. Conservative Medicine as applied to Therapeutics. III. Conservative Medicine as applied to Hygiene. IV. Medicine in the Past, the Present, and the Future. V. Alimentation in Disease. VI. Tolerance of Disease. VII. On the Agency of the Mind in Etiology, Prophylaxis, and Therapeutics. VIII. Divine design as exemplified in the Natural History of Disease.

WATSON (THOMAS), M. D., &c.

LECTURES ON THE PRINCIPLES AND PRACTICE OF PHYSIC. Delivered at King's College, London. A new American, from the Fifth revised and enlarged English edition. Edited, with additions, and several hundred illustrations, by HENRY HARTSHORNE, M.D., Professor of Hygiene in the University of Pennsylvania. In two large and handsome 8vo. vols. Cloth, $9 00; leather, $11 00. (*Just Issued.*)

It is a subject for congratulation and for thankfulness that Sir Thomas Watson, during a period of comparative leisure, after a long, laborious, and most honorable professional career, while retaining full possession of his high mental faculties, should have employed the opportunity to submit his Lectures to a more thorough revision than was possible during the earlier and busier period of his life. Carefully passing in review some of the most intricate and important pathological and practical questions, the results of his clear insight and his calm judgment are now recorded for the benefit of mankind, in language which, for precision, vigor, and classical elegance, has rarely been equalled, and never surpassed. The revision has evidently been most carefully done, and the results appear in almost every page.—*Brit. Med. Journ.*, Oct. 14, 1871.

The lectures are so well known and so justly appreciated, that it is scarcely necessary to do more than call attention to the special advantages of the last over previous editions. The author's rare combination of great scientific attainments combined with wonderful forensic eloquence has exerted extraordinary influence over the last two generations of physicians. His clinical descriptions of most diseases have never been equalled; and on this score at least his work will live long in the future. The work will be sought by all who appreciate a great book.—*Amer. Journ. of Syphilography*, July, 1872.

We are exceedingly gratified at the reception of this new edition of Watson, pre-eminently the prince of English authors, on "Practice." We, who read the first edition shall never forget the great pleasure and profit we derived from its graphic delineations of disease, its vigorous style and splendid English. Maturity of years, extensive observation, profound research, and yet continuous enthusiasm, have combined to give us in this latest edition a model of professional excellence in teaching with rare beauty in the mode of communication. But this *classic* needs no eulogium of ours.—*Chicago Med. Journ.*, July, 1872

DUNGLISON, FORBES, TWEEDIE, AND CONOLLY.

THE CYCLOPÆDIA OF PRACTICAL MEDICINE: comprising Treatises on the Nature and Treatment of Diseases, Materia Medica and Therapeutics, Diseases of Women and Children, Medical Jurisprudence, &c. &c. In four large super-royal octavo volumes, of 3254 double-columned pages, strongly and handsomely bound in leather, $15; cloth, $11.

HARTSHORNE (HENRY), M.D.,
Professor of Hygiene in the University of Pennsylvania.

ESSENTIALS OF THE PRINCIPLES AND PRACTICE OF MEDICINE. A handy-book for Students and Practitioners. Fourth edition, revised and improved. With about one hundred illustrations. In one handsome royal 12mo. volume, of about 550 pages, cloth, $2 63; half bound, $2 88. (*Just Ready.*)

This little epitome of medical knowledge has already been noticed by us. It is a vade mecum of value, including in a short space most of what is essential in the science and practice of medicine. The third edition is well up to the present day in the modern methods of treatment, and in the use of newly discovered drugs.—*Boston Med. and Surg. Journal*, Oct. 19, 1871.

Certainly very few volumes contain so much precise information within so small a compass.—*N. Y. Med. Journal*, Nov. 1871.

The diseases are conveniently classified; symptoms, causation, diagnosis, prognosis, and treatment are carefully considered, the whole being marked by briefness, but clearness of expression. Over 250 formulas are appended, intended as examples merely, not as guides for unthinking practitioners. A complete index facilitates the use of this little volume, in which all important remedies lately introduced, such as chloral hydrate and carbolic acid, have received their full share of attention.—*Am. Journ. of Pharm.*, Nov. 1871.

It is an epitome of the whole science and practice of medicine, and will be found most valuable to the practitioner for easy reference, and especially to the student in attendance upon lectures, whose time is too much occupied with many studies, to consult the larger works. Such a work must always be in great demand.—*Cincinnati Med. Repertory*, Nov. 1871.

PAVY (F. W.), M. D., F. R. S.,
Senior Asst. Physician to and Lecturer on Physiology, at Guy's Hospital, &c.

A TREATISE ON THE FUNCTION OF DIGESTION; its Disorders and their Treatment. From the second London edition. In one handsome volume, small octavo, cloth, $2 00. (*Lately Published.*)

BY THE SAME AUTHOR. (*Just Ready.*)

A TREATISE ON FOOD AND DIETETICS, PHYSIOLOGICALLY AND THERAPEUTICALLY CONSIDERED. In one handsome octavo volume of nearly 600 pages, cloth, $4 75.

SUMMARY OF CONTENTS.

Introductory Remarks on the Dynamic Relations of Food—On the Origination of Food—The Constituent Relations of Food—Alimentary Principles, their Classification, Chemical Relations, Digestion, Assimilation, and Physiological Uses—Nitrogenous Alimentary Principles—Non-Nitrogenous Alimentary Principles—The Carbo-Hydrates—The Inorganic Alimentary Principles—Alimentary Substances—Animal Alimentary Substances—Vegetable Alimentary Substances—Beverages—Condiments—The Preservation of Food—Principles of Dietetics—Practical Dietetics—Diet of Infants—Diet for Training—Therapeutic Dietetics—Dietetic Preparations for the Invalid—Hospital Dietaries.

CHAMBERS (T. K.), M. D.,
Consulting Physician to St. Mary's Hospital, London, &c.

THE INDIGESTIONS; or, Diseases of the Digestive Organs Functionally Treated. Third and revised Edition. In one handsome octavo volume of 383 pages, cloth $3 00. (*Lately Published.*)

From this purely material point of view, setting aside its higher claims to merit, we know of no more desirable acquisition to a physician's library than the book before us. He who should commit its contents to his memory would find its price an investment of capital that returned him a most usurious rate of interest.—*N. Y. Medical Gazette*, Jan. 28, 1871.

BY THE SAME AUTHOR. (*Lately Published.*)

RESTORATIVE MEDICINE. An Harveian Annual Oration. With Two Sequels. In one very handsome volume, small 12mo., cloth, $1 00.

BY THE SAME AUTHOR. (*Shortly.*)

A MANUAL OF DIET AND REGIMEN IN HEALTH AND SICKNESS. In one handsome octavo volume.

FOX (WILSON), M.D.,
Holme Prof. of Clinical Med., University Coll., London.

THE DISEASES OF THE STOMACH: Being the Third Edition of the "Diagnosis and Treatment of the Varieties of Dyspepsia." Revised and Enlarged. With illustrations. In one handsome octavo volume. (*Ready in December.*)

The present edition of Dr. Wilson Fox's very admirable work differs from the preceding in that it deals with other maladies than dyspepsia only.—*London Med. Times*, Feb. 8, 1873.

Dr. Fox has put forth a volume of uncommon excellence, which we feel very sure will take a high rank among works that treat of the stomach.—*Am. Practitioner*, March, 1873.

BRINTON (WILLIAM), M.D., F.R.S.

LECTURES ON THE DISEASES OF THE STOMACH; with an Introduction on its Anatomy and Physiology. From the second and enlarged London edition. With illustrations on wood In one handsome octavo volume of about 300 pages, cloth, $3 25.

FLINT (AUSTIN), M. D.,

Professor of the Principles and Practice of Medicine in Bellevue Hospital Med. College, N. Y

A PRACTICAL TREATISE ON THE DIAGNOSIS, PATHOLOGY, AND TREATMENT OF DISEASES OF THE HEART.

Second revised and enlarged edition. In one octavo volume of 550 pages, with a plate, cloth, $4.

The author has sedulously improved the opportunity afforded him of revising this work. Portions of it have been rewritten, and the whole brought up to a level with the most advanced condition of science. It must therefore continue to maintain its position as the standard treatise on the subject.

Dr. Flint chose a difficult subject for his researches, and has shown remarkable powers of observation and reflection, as well as great industry, in his treatment of it. His book must be considered the fullest and clearest practical treatise on those subjects, and should be in the hands of all practitioners and students. It is a credit to American medical literature. —*Amer. Journ. of the Med. Sciences*, July, 1860.

We question the fact of any recent American author in our profession being more extensively known, or more deservedly esteemed in this country than Dr. Flint. We willingly acknowledge his success, more particularly in the volume on diseases of the heart, in making an extended personal clinical study available for purposes of illustration, in connection with cases which have been reported by other trustworthy observers.—*Brit. and For. Med.-Chirurg. Review.*

In regard to the merits of the work, we have no hesitation in pronouncing it full, accurate, and judicious. Considering the present state of science, such a work was much needed. It should be in the hands of every practitioner.—*Chicago Med. Journ.*

With more than pleasure do we hail the advent of this work, for it fills a wide gap on the list of text-books for our schools, and is, for the practitioner, the most valuable practical work of its kind.—*N. O. Med News.*

BY THE SAME AUTHOR.

A PRACTICAL TREATISE ON THE PHYSICAL EXPLORATION OF THE CHEST AND THE DIAGNOSIS OF DISEASES AFFECTING THE RESPIRATORY ORGANS.

Second and revised edition. In one handsome octavo volume of 595 pages, cloth, $4 50.

Dr. Flint's treatise is one of the most trustworthy guides which we can consult. The style is clear and distinct, and is also concise, being free from that tendency to over-refinement and unnecessary minuteness which characterizes many works on the same subject.—*Dublin Medical Press*, Feb. 6, 1867.

The chapter on Phthisis is replete with interest; and his remarks on the diagnosis, especially in the early stages, are remarkable for their acumen and great practical value. Dr. Flint's style is clear and elegant, and the tone of freshness and originality which pervades his whole work lend an additional force to its thoroughly practical character, which cannot fail to obtain for it a place as a standard work on diseases of the respiratory system.—*London Lancet*, Jan. 19, 1867.

This is an admirable book. Excellent in detail and execution, nothing better could be desired by the practitioner. Dr. Flint enriches his subject with much solid and not a little original observation.—*Ranking's Abstract*, Jan. 1867.

FULLER (HENRY WILLIAM), M. D.,

Physician to St George's Hospital, London.

ON DISEASES OF THE LUNGS AND AIR-PASSAGES.

Their Pathology, Physical Diagnosis, Symptoms, and Treatment. From the second and revised English edition. In one handsome octavo volume of about 500 pages, cloth, $3 50.

Dr. Fuller's work on diseases of the chest was so favorably received, that to many who did not know the extent of his engagements, it was a matter of wonder that it should be allowed to remain three years out of print. Determined, however, to improve it, Dr. Fuller would not consent to a mere reprint, and accordingly we have what might be with perfect justice styled an entirely new work from his pen, the portion of the work treating of the heart and great vessels being excluded. Nevertheless, this volume is of almost equal size with the first.—*London Medical Times and Gazette*, July 20, 1867.

WILLIAMS (C. J. B.), M.D.,

Senior Consulting Physician to the Hospital for Consumption, Brompton, and

WILLIAMS (CHARLES T.), M.D.,

Physician to the Hospital for Consumption.

PULMONARY CONSUMPTION; Its Nature, Varieties, and Treatment.

With an Analysis of One Thousand Cases to exemplify its duration. In one neat octavo volume of about 350 pages, cloth, $2 50. (*Just Issued.*)

He can still speak from a more enormous experience, and a closer study of the morbid processes involved in tuberculosis, than most living men. He owed it to himself, and to the importance of the subject, to embody his views in a separate work, and we are glad that he has accomplished this duty. After all, the grand teaching which Dr Williams has for the profession is to be found in his therapeutical chapters, and in the history of individual cases extended, by dint of care, over ten, twenty, thirty, and even forty years.—*London Lancet*, Oct. 21, 1871.

His results are more favorable than those of any previous author; but probably there is no malady, the treatment of which has been so much improved within the last twenty years as pulmonary consumption. To ourselves, Dr. Williams's chapters on Treatment are amongst the most valuable and attractive in the book, and would alone render it a standard work of reference. In conclusion, we would record our opinion that Dr. Williams's great reputation is fully maintained by this book. It is undoubtedly one of the most valuable works in the language upon any special disease.—*Lond. Med. Times and Gaz.*, Nov. 4, 1871.

LA ROCHE ON PNEUMONIA. 1 vol. 8vo., cloth, of 500 pages Price $3 00.

SMITH ON CONSUMPTION; ITS EARLY AND REMEDIABLE STAGES. 1 vol. 8vo., pp. 254. $2 25

WALSHE ON THE DISEASES OF THE HEART AND GREAT VESSELS. Third American edition. In 1 vol. 8vo., 420 pp., cloth. $3 00.

ROBERTS (WILLIAM), M. D.,
Lecturer on Medicine in the Manchester School of Medicine, &c.

A PRACTICAL TREATISE ON URINARY AND RENAL DISEASES, including Urinary Deposits. Illustrated by numerous cases and engravings. Second American, from the Second Revised and Enlarged London Edition. In one large and handsome octavo volume of 616 pages, with a colored plate; cloth, $4 50. (*Just Issued.*)

The author has subjected this work to a very thorough revision, and has sought to embody in it the results of the latest experience and investigations. Although every effort has been made to keep it within the limits of its former size, it has been enlarged by a hundred pages, many new wood-cuts have been introduced, and also a colored plate representing the appearance of the different varieties of urine, while the price has been retained at the former very moderate rate.

The plan, it will thus be seen, is very complete, and the manner in which it has been carried out is in the highest degree satisfactory. The characters of the different deposits are very well described, and the microscopic appearances they present are illustrated by numerous well executed engravings. It only remains to us to strongly recommend to our readers Dr. Roberts's work, as containing an admirable *résumé* of the present state of knowledge of urinary diseases, and as a safe and reliable guide to the clinical observer.—*Edin. Med. Jour.*

The most complete and practical treatise upon renal diseases we have examined. It is peculiarly adapted to the wants of the majority of American practitioners from its clearness and simple announcement of the facts in relation to diagnosis and treatment of urinary disorders, and contains in condensed form the investigations of Bence Jones, Bird, Beale, Hassall, Prout, and a host of other well-known writers upon this subject. The characters of urine, physiological and pathological, as indicated to the naked eye as well as by microscopical and chemical investigations, are concisely represented both by description and by well executed engravings.—*Cincinnati Journ. of Med.*

BASHAM (W. R.), M. D.,
Senior Physician to the Westminster Hospital, &c.

RENAL DISEASES: a Clinical Guide to their Diagnosis and Treatment. With illustrations. In one neat royal 12mo. volume of 304 pages, cloth, $2 00.

The chapters on diagnosis and treatment are very good, and the student and young practitioner will find them full of valuable practical hints. The third part, on the urine, is excellent, and we cordially recommend its perusal. The author has arranged his matter in a somewhat novel, and, we think, useful form. Here everything can be easily found, and, what is more important, easily read, for all the dry details of larger books here acquire a new interest from the author's arrangement. This part of the book is full of good work.—*Brit. and For. Medico-Chirurgical Review*, July, 1870.

The easy descriptions and compact modes of statement render the book pleasing and convenient.—*Am. Journ. Med. Sciences*, July, 1870.

JONES (C. HANDFIELD), M. D.,
Physician to St. Mary's Hospital, &c.

CLINICAL OBSERVATIONS ON FUNCTIONAL NERVOUS DISORDERS. Second American Edition. In one handsome octavo volume of 348 pages, cloth, $3 25.

Taken as a whole, the work before us furnishes a short but reliable account of the pathology and treatment of a class of very common but certainly highly obscure disorders. The advanced student will find it a rich mine of valuable facts, while the medical practitioner will derive from it many a suggestive hint to aid him in the diagnosis of "nervous cases," and in determining the true indications for their amelioration or cure.—*Amer. Journ. Med. Sci.*, Jan. 1867.

LINCOLN (D. F.). M.D.,
Physician to the Department of Nervous Diseases, Boston Dispensary.

ELECTRO THERAPEUTICS; A Concise Manual of Medical Electricity. In one very neat royal 12mo. volume, cloth, with illustrations, $1 50. (*Just Ready.*)

The chief aim of the present volume has been the analysis of the principles which ought to govern our use of Electricity. The portions describing the practical applications which have been made of it in various disorders, may be found incomplete, but it is hoped that enough has been said to satisfy the needs of the general practitioner.—PREFACE.

SUMMARY OF CONTENTS.

CHAPTER I. Physical Laws.—II. Modes of Generating Electricity.—III. Physiology.—IV. Diagnosis.—V. Methods of Applying Electricity.—VI. Medical and Surgical Practice.—VII. Cautions.—VIII. Apparatus.

SLADE (D. D.), M.D.

DIPHTHERIA; its Nature and Treatment, with an account of the History of its Prevalence in various Countries. Second and revised edition. In one neat royal 12mo. volume, cloth, $1 25.

HUDSON (A.), M. D., M. R. I. A.,
Physician to the Meath Hospital.

LECTURES ON THE STUDY OF FEVER. In one vol. 8vo., cloth, $2 50.

LYONS (ROBERT D.), K.C.C.

A TREATISE ON FEVER. In one octavo volume of 362 pages; cloth, $2 25.

BUMSTEAD (FREEMAN J.), M. D.,
Professor of Venereal Diseases at the Col. of Phys. and Surg., New York, &c.

THE PATHOLOGY AND TREATMENT OF VENEREAL DISEASES. Including the results of recent investigations upon the subject. Third edition, revised and enlarged, with illustrations. In one large and handsome octavo volume of over 700 pages, cloth, $5 00; leather, $6 00. (*Just Issued.*)

In preparing this standard work again for the press, the author has subjected it to a very thorough revision. Many portions have been rewritten, and much new matter added, in order to bring it completely on a level with the most advanced condition of syphilography, but by careful compression of the text of previous editions, the work has been increased by only sixty-four pages. The labor thus bestowed upon it, it is hoped, will insure for it a continuance of its position as a complete and trustworthy guide for the practitioner.

It is the most complete book with which we are acquainted in the language. The latest views of the best authorities are put forward, and the information is well arranged—a great point for the student, and still more for the practitioner. The subjects of visceral syphilis, syphilitic affections of the eyes, and the treatment of syphilis by repeated inoculations, are very fully discussed.—*London Lancet*, Jan. 7, 1871.

Dr. Bumstead's work is already so universally known as the best treatise in the English language on venereal diseases, that it may seem almost superfluous to say more of it than that a new edition has been issued. But the author's industry has rendered this new edition virtually a new work, and so merits as much special commendation as if its predecessors had not been published. As a thoroughly practical book on a class of diseases which form a large share of nearly every physician's practice, the volume before us is by far the best of which we have knowledge.—*N. Y. Medical Gazette*, Jan. 28, 1871.

It is rare in the history of medicine to find any one book which contains all that a practitioner needs to know; while the possessor of "Bumstead on Venereal" has no occasion to look outside of its covers for anything practical connected with the diagnosis, history, or treatment of these affections.—*N. Y. Medical Journal*, March, 1871.

CULLERIER (A.), *Surgeon to the Hôpital du Midi.* and BUMSTEAD (FREEMAN J.), *Professor of Venereal Diseases in the College of Physicians and Surgeons, N. Y.*

AN ATLAS OF VENEREAL DISEASES. Translated and Edited by FREEMAN J. BUMSTEAD. In one large imperial 4to. volume of 328 pages, double-columns, with 26 plates, containing about 150 figures, beautifully colored, many of them the size of life; strongly bound in cloth, $17 00; also, in five parts, stout wrappers for mailing, at $3 per part. (*Lately Published.*)

Anticipating a very large sale for this work, it is offered at the very low price of THREE DOLLARS a Part, thus placing it within the reach of all who are interested in this department of practice. Gentlemen desiring early impressions of the plates would do well to order it without delay.

A specimen of the plates and text sent free by mail, on receipt of 25 cents.

We wish for once that our province was not restricted to methods of treatment, that we might say something of the exquisite colored plates in this volume.—*London Practitioner*, May, 1869.

As a whole, it teaches all that can be taught by means of plates and print.—*London Lancet*, March 13, 1869.

Superior to anything of the kind ever before issued on this continent.—*Canada Med. Journal*, March, '69.

The practitioner who desires to understand this branch of medicine thoroughly should obtain this, the most complete and best work ever published.—*Dominion Med. Journal*, May, 1869.

This is a work of master hands on both sides. M. Cullerier is scarcely second to, we think we may truly say is a peer of the illustrious and venerable Ricord, while in this country we do not hesitate to say that Dr. Bumstead, as an authority, is without a rival Assuring our readers that these illustrations tell the whole history of venereal disease, from its inception to its end, we do not know a single medical work, which for its kind is more *necessary* for them to have.—*California Med. Gazette*, March, 1869.

The most splendidly illustrated work in the language, and in our opinion far more useful than the French original.—*Am. Journ. Med. Sciences*, Jan.'69.

The fifth and concluding number of this magnificent work has reached us, and we have no hesitation in saying that its illustrations surpass those of previous numbers.—*Boston Med. and Surg. Journal*, Jan. 14, 1869.

Other writers besides M. Cullerier have given us a good account of the diseases of which he treats, but no one has furnished us with such a complete series of illustrations of the venereal diseases. There is, however, an additional interest and value possessed by the volume before us; for it is an American reprint and translation of M. Cullerier's work, with incidental remarks by one of the most eminent American syphilographers, Mr. Bumstead.—*Brit. and For. Medico-Chir. Review*, July, 1869.

HILL (BERKELEY),
Surgeon to the Lock Hospital, London.

ON SYPHILIS AND LOCAL CONTAGIOUS DISORDERS. In one handsome octavo volume; cloth, $3 25.

Bringing, as it does, the entire literature of the disease down to the present day, and giving with great ability the results of modern research, it is in every respect a most desirable work, and one which should find a place in the library of every surgeon.—*California Med. Gazette*, June, 1869.

Considering the scope of the book and the careful attention to the manifold aspects and details of its subject, it is wonderfully concise All these qualities render it an especially valuable book to the beginner, to whom we would most earnestly recommend its study; while it is no less useful to the practitioner.—*St. Louis Med. and Surg. Journal*, May, 1869.

The most convenient and ready book of reference we have met with.—*N. Y. Med. Record*, May 1, 1869.

Most admirably arranged for both student and practitioner, no other work on the subject equals it; it is more simple, more easily studied.—*Buffalo Med. and Surg. Journal*, March, 1869.

ZEISSL (H.), M.D.

A COMPLETE TREATISE ON VENEREAL DISEASES. Translated from the Second Enlarged German Edition, by FREDERIC R. STURGIS, M.D In one octavo volume, with illustrations. (*Preparing.*)

WILSON (ERASMUS), F.R.S.

ON DISEASES OF THE SKIN. With Illustrations on wood. Seventh American, from the sixth and enlarged English edition. In one large octavo volume of over 800 pages, $5.

A SERIES OF PLATES ILLUSTRATING "WILSON ON DISEASES OF THE SKIN;" consisting of twenty beautifully executed plates, of which thirteen are exquisitely colored, presenting the Normal Anatomy and Pathology of the Skin, and embracing accurate representations of about one hundred varieties of disease, most of them the size of nature. Price, in extra cloth, $5 50.

Also, the Text and Plates, bound in one handsome volume. Cloth, $10.

No one treating skin diseases should be without a copy of this standard work.—*Canada Lancet.*

We can safely recommend it to the profession as the best work on the subject now in existence in the English language.—*Medical Times and Gazette*

Mr. Wilson's volume is an excellent digest of the actual amount of knowledge of cutaneous diseases it includes almost every fact or opinion of importance connected with the anatomy and pathology of the skin.—*British and Foreign Medical Review.*

Such a work as the one before us is a most capital and acceptable help. Mr. Wilson has long been held as high authority in this department of medicine, and his book on diseases of the skin has long been regarded as one of the best text-books extant on the subject. The present edition is carefully prepared, and brought up in its revision to the present time. In this edition we have also included the beautiful series of plates illustrative of the text, and in the last edition published separately. There are twenty of these plates, nearly all of them colored to nature, and exhibiting with great fidelity the various groups of diseases.—*Cincinnati Lancet.*

BY THE SAME AUTHOR.

THE STUDENT'S BOOK OF CUTANEOUS MEDICINE and DISEASES OF THE SKIN. In one very handsome royal 12mo. volume. $3 50. (*Lately Issued.*)

NELIGAN (J. MOORE), M.D., M.R.I.A.

A PRACTICAL TREATISE ON DISEASES OF THE SKIN. Fifth American, from the second and enlarged Dublin edition by T. W. Belcher, M.D. In one neat royal 12mo. volume of 462 pages, cloth, $2 25.

Fully equal to all the requirements of students and young practitioners.—*Dublin Med. Press.*

Of the remainder of the work we have nothing beyond unqualified commendation to offer. It is so far the most complete one of its size that has appeared, and for the student there can be none which can compare with it in practical value. All the late discoveries in Dermatology have been duly noticed, and their value justly estimated; in a word, the work is fully up to the times, and is thoroughly stocked with most valuable information.—*New York Med. Record*, Jan. 15, 1867.

The most convenient manual of diseases of the skin that can be procured by the student.—*Chicago Med. Journal*, Dec. 1866.

BY THE SAME AUTHOR.

ATLAS OF CUTANEOUS DISEASES. In one beautiful quarto volume, with exquisitely colored plates, &c., presenting about one hundred varieties of disease. Cloth, $5 50.

The diagnosis of eruptive disease, however, under all circumstances, is very difficult. Nevertheless, Dr. Neligan has certainly, "as far as possible," given a faithful and accurate representation of this class of diseases, and there can be no doubt that these plates will be of great use to the student and practitioner in drawing a diagnosis as to the class, order, and species to which the particular case may belong. While looking over the "Atlas" we have been induced to examine also the "Practical Treatise," and we are inclined to consider it a very superior work, combining accurate verbal description with sound views of the pathology and treatment of eruptive diseases. —*Glasgow Med. Journal.*

A compend which will very much aid the practitioner in this difficult branch of diagnosis. Taken with the beautiful plates of the Atlas, which are remarkable for their accuracy and beauty of coloring, it constitutes a very valuable addition to the library of a practical man.—*Buffalo Med. Journal.*

HILLIER (THOMAS), M.D.,

Physician to the Skin Department of University College Hospital, &c.

HAND-BOOK OF SKIN DISEASES, for Students and Practitioners. Second American Edition. In one royal 12mo. volume of 358 pp. With Illustrations. Cloth, $2 25.

We can conscientiously recommend it to the student; the style is clear and pleasant to read, the matter is good, and the descriptions of disease, with the modes of treatment recommended, are frequently illustrated with well-recorded cases.—*London Med. Times and Gazette*, April 1, 1865.

It is a concise, plain, practical treatise on the various diseases of the skin; just such a work, indeed, as was much needed, both by medical students and practitioners. — *Chicago Medical Examiner*, May, 1865.

ANDERSON (McCALL), M.D.,

Physician to the Dispensary for Skin Diseases, Glasgow, &c.

ON THE TREATMENT OF DISEASES OF THE SKIN. With an Analysis of Eleven Thousand Consecutive Cases. In one vol. 8vo. $1. (*Just Ready.*)

GUERSANT'S SURGICAL DISEASES OF INFANTS AND CHILDREN. Translated by R. J. DUNGLISON, M.D. 1 vol. 8vo. Cloth, $2 50.

DEWEES ON THE PHYSICAL AND MEDICAL TREATMENT OF CHILDREN. Eleventh edition. 1 vol. 8vo. of 548 pages. Cloth, $2 80.

SMITH (J. LEWIS), M. D.,
Professor of Morbid Anatomy in the Bellevue Hospital Med. College, N. Y.

A COMPLETE PRACTICAL TREATISE ON THE DISEASES OF CHILDREN. Second Edition, revised and greatly enlarged. In one handsome octavo volume of 742 pages, cloth, $5; leather, $6. (*Just Issued.*)

FROM THE PREFACE TO THE SECOND EDITION.

In presenting to the profession the second edition of his work, the author gratefully acknowledges the favorable reception accorded to the first. He has endeavored to merit a continuance of this approbation by rendering the volume much more complete than before. Nearly twenty additional diseases have been treated of, among which may be named Diseases Incidental to Birth, Rachitis, Tuberculosis, Scrofula, Intermittent, Remittent, and Typhoid Fevers, Chorea, and the various forms of Paralysis. Many new formulæ, which experience has shown to be useful, have been introduced, portions of the text of a less practical nature have been condensed, and other portions, especially those relating to pathological histology, have been rewritten to correspond with recent discoveries. Every effort has been made, however, to avoid an undue enlargement of the volume, but, notwithstanding this, and an increase in the size of the page, the number of pages has been enlarged by more than one hundred.

227 WEST 49TH STREET, NEW YORK, April, 1872.

The work will be found to contain nearly one-third more matter than the previous edition, and it is confidently presented as in every respect worthy to be received as the standard American text-book on the subject.

Eminently practical as well as judicious in its teachings.—*Cincinnati Lancet and Obs.*, July, 1872.

A standard work that leaves little to be desired.—*Indiana Journal of Medicine*, July, 1872.

We know of no book on this subject that we can more cordially recommend to the medical student and the practitioner.—*Cincinnati Clinic*, June 29, '72.

We regard it as superior to any other single work on the diseases of infancy and childhood.—*Detroit Rev. of Med. and Pharmacy*, Aug. 1872.

We confess to increased enthusiasm in recommending this second edition.—*St. Louis Med. and Surg. Journal*, Aug. 1872.

CONDIE (D. FRANCIS), M. D.

A PRACTICAL TREATISE ON THE DISEASES OF CHILDREN. Sixth edition, revised and augmented. In one large octavo volume of nearly 800 closely-printed pages, cloth, $5 25; leather, $6 25. (*Lately Issued.*)

The present edition, which is the sixth, is fully up to the times in the discussion of all those points in the pathology and treatment of infantile diseases which have been brought forward by the German and French teachers. As a whole, however, the work is the best American one that we have, and in its special adaptation to American practitioners it certainly has no equal.—*New York Med. Record*, March 2, 1868.

WEST (CHARLES), M. D.,
Physician to the Hospital for Sick Children, &c.

LECTURES ON THE DISEASES OF INFANCY AND CHILDHOOD. Fifth American from the sixth revised and enlarged English edition. In one large and handsome octavo volume of 678 pages. Cloth, $4 50; leather, $5 50. (*Just Ready.*)

The continued demand for this work on both sides of the Atlantic, and its translation into German, French, Italian, Danish, Dutch, and Russian, show that it fills satisfactorily a want extensively felt by the profession. There is probably no man living who can speak with the authority derived from a more extended experience than Dr. West, and his work now presents the results of nearly 2000 recorded cases, and 600 post-mortem examinations selected from among nearly 40,000 cases which have passed under his care. In the preparation of the present edition he has omitted much that appeared of minor importance, in order to find room for the introduction of additional matter, and the volume, while thoroughly revised, is therefore not increased materially in size.

Of all the English writers on the diseases of children, there is no one so entirely satisfactory to us as Dr. West. For years we have held his opinion as judicial, and have regarded him as one of the highest living authorities in the difficult department of medical science in which he is most widely known.—*Boston Med. and Surg. Journal.*

BY THE SAME AUTHOR. (*Lately Issued.*)

ON SOME DISORDERS OF THE NERVOUS SYSTEM IN CHILDHOOD; being the Lumleian Lectures delivered at the Royal College of Physicians of London, in March, 1871. In one volume, small 12mo., cloth, $1 00.

SMITH (EUSTACE), M. D.,
Physician to the Northwest London Free Dispensary for Sick Children.

A PRACTICAL TREATISE ON THE WASTING DISEASES OF INFANCY AND CHILDHOOD. Second American, from the second revised and enlarged English edition. In one handsome octavo volume, cloth, $2 50. (*Lately Issued.*)

This is in every way an admirable book. The modest title which the author has chosen for it scarcely conveys an adequate idea of the many subjects upon which it treats. Wasting is so constant an attendant upon the maladies of childhood, that a treatise upon the wasting diseases of children must necessarily embrace the consideration of many affections of which it is a symptom; and this is excellently well done by Dr. Smith. The book might fairly be described as a practical handbook of the common diseases of children, so numerous are the affections considered either collaterally or directly. We are acquainted with no safer guide to the treatment of children's diseases, and few works give the insight into the physiological and other peculiarities of children that Dr. Smith's book does.—*Brit. Med. Journ.*, April 8, 1871.

THE OBSTETRICAL JOURNAL.

THE OBSTETRICAL JOURNAL of Great Britain and Ireland; Including MIDWIFERY, and the DISEASES OF WOMEN AND INFANTS. With an American Supplement, edited by WILLIAM F. JENKS, M.D. A monthly of about 80 octavo pages, very handsomely printed. Subscription, Five Dollars per annum. Single Numbers, 50 cents each.

Commencing with April, 1873, the Obstetrical Journal consists of Original Papers by British and Foreign Contributors; Transactions of the Obstetrical Societies in England and abroad; Reports of Hospital Practice; Reviews and Bibliographical Notices; Articles and Notes, Editorial, Historical, Forensic, and Miscellaneous; Selections from Journals; Correspondence, &c. Collecting together the vast amount of material daily accumulating in this important and rapidly improving department of medical science, the value of the information which it presents to the subscriber may be estimated from the character of the gentlemen who have already promised their support, including such names as those of Drs. ATTHILL, ROBERT BARNES, HENRY BENNET, THOMAS CHAMBERS, FLEETWOOD CHURCHILL, MATTHEWS DUNCAN, GRAILY HEWITT, BRAXTON HICKS, ALFRED MEADOWS, W. LEISHMAN, ALEX. SIMPSON, TYLER SMITH, EDWARD J. TILT, SPENCER WELLS, &c. &c.; in short, the representative men of British Obstetrics and Gynæcology.

In order to render the OBSTETRICAL JOURNAL fully adequate to the wants of the American profession, each number contains a Supplement devoted to the advances made in Obstetrics and Gynæcology on this side of the Atlantic. This portion of the Journal is under the editorial charge of Dr. WILLIAM F. JENKS, to whom editorial communications, exchanges, books for review, &c., may be addressed, to the care of the publisher.

*** Complete sets from the beginning can no longer be furnished, but subscriptions can commence with January, 1874, or with Vol. II., April, 1874.

THOMAS (T. GAILLARD), M.D.,

Professor of Obstetrics, &c., in the College of Physicians and Surgeons, N. Y., &c.

A PRACTICAL TREATISE ON THE DISEASES OF WOMEN. Fourth edition, enlarged and thoroughly revised. In one large and handsome octavo volume of 800 pages, with 191 illustrations. Cloth, $5 00; leather, $6 00. (*Now Ready.*)

The author has taken advantage of the opportunity afforded by the call for another edition of this work to render it worthy a continuance of the very remarkable favor with which it has been received. Every portion has been subjected to a conscientious revision, and no labor has been spared to make it a complete treatise on the most advanced condition of its important subject.

A few notices of the previous editions are subjoined:—

Professor Thomas fairly took the Profession of the United States by storm when his book first made its appearance early in 1868. Its reception was simply enthusiastic, notwithstanding a few adverse criticisms from our transatlantic brethren, the first large edition was rapidly exhausted, and in six months a second one was issued, and in two years a third one was announced and published, and we are now promised the fourth. The popularity of this work was not ephemeral, and its success was unprecedented in the annals of American medical literature. Six years is a long period in medical scientific research, but Thomas's work on "Diseases of Women" is still the leading native production of the United States. The order, the matter, the absence of theoretical disputativeness, the fairness of statement, and the elegance of diction, preserved throughout the entire range of the book, indicate that Professor Thomas did not overestimate his powers when he conceived the idea and executed the work of producing a new treatise upon diseases of women.—PROF. PALLEN, in *Louisville Med. Journal*, Sept. 1874.

Briefly, we may say that we know of no book which so completely and concisely represents the present state of gynæcology; none so full of well-digested and reliable teaching; none which bespeaks an author more apt in research and abundant in resources.—*N. Y. Med. Record*, May 1, 1872.

We should not be doing our duty to the profession did we not tell those who are unacquainted with the book, how much it is valued by gynæcologists, and how it is in many respects one of the best text-books on the subject we possess in our language. We have no hesitation in recommending Dr. Thomas's work as one of the most complete of its kind ever published. It should be in the possession of every practitioner for reference and for study.—*London Lancet*, April 27, 1872.

We are free to say that we regard Dr. Thomas the best American authority on diseases of women.—*Cincinnati Lancet and Observer*, May, 1872.

No general practitioner can afford to be without it.—*St. Louis Med. and Surg. Journal*, May, 1872.

Its able author need not fear comparison between it and any similar work in the English language; nay more, as a text-book for students and as a guide for practitioners, we believe it is unequalled. If either student or practitioner can get but one book on diseases of women, that book should be "Thomas."—*Amer. Jour. Med. Sciences*, April, 1872.

To students we unhesitatingly recommend it as the best text-book on diseases of females extant.—*St. Louis Med. Reporter*, June, 1869.

Of all the army of books that have appeared of late years, on the diseases of the uterus and its appendages, we know of none that is so clear, comprehensive, and practical as this of Dr. Thomas', or one that we should more emphatically recommend to the young practitioner, as his guide.—*California Med. Gazette*, June, 1869.

It would be superfluous to give an extended review of what is now firmly established as *the* American text-book of Gynæcology.—*N. Y. Med. Gazette*, July 17, 1869.

This is a new and revised edition of a work which we recently noticed at some length, and earnestly commended to the favorable attention of our readers. The fact that, in the short space of one year, this second edition makes its appearance, shows that the general judgment of the profession has largely confirmed the opinion we gave at that time.—*Cincinnati Lancet*, Aug. 1869.

It is so short a time since we gave a full review of the first edition of this book, that we deem it only necessary now to call attention to the second appearance of the work. Its success has been remarkable, and we can only congratulate the author on the brilliant reception his book has received.—*N. Y. Med. Journal*, April, 1869.

HODGE (HUGH L.), M.D.,
Emeritus Professor of Obstetrics, &c., in the University of Pennsylvania.

ON DISEASES PECULIAR TO WOMEN; including Displacements of the Uterus. With original illustrations. Second edition, revised and enlarged. In one beautifully printed octavo volume of 531 pages, cloth, $4 50. (*Lately Issued.*)

From PROF. W. H. BYFORD, *of the Rush Medical College, Chicago.*

The book bears the impress of a master hand, and must, as its predecessor, prove acceptable to the profession. In diseases of women Dr. Hodge has established a school of treatment that has become world-wide in fame.

Professor Hodge's work is truly an original one from beginning to end, consequently no one can peruse its pages without learning something new. The book, which is by no means a large one, is divided into two grand sections, so to speak: first, that treating of the nervous sympathies of the uterus, and, secondly, that which speaks of the mechanical treatment of displacements of that organ. He is disposed, as a non-believer in the frequency of inflammations of the uterus, to take strong ground against many of the highest authorities in this branch of medicine, and the arguments which he offers in support of his position are, to say the least, well put. Numerous woodcuts adorn this portion of the work, and add incalculably to the proper appreciation of the variously shaped instruments referred to by our author. As a contribution to the study of women's diseases, it is of great value, and is abundantly able to stand on its own merits.—*N. Y. Medical Record*, Sept. 15, 1868.

WEST (CHARLES), M.D.

LECTURES ON THE DISEASES OF WOMEN. Third American, from the Third London edition. In one neat octavo volume of about 550 pages, cloth, $3 75; leather, $4 75.

As a writer, Dr. West stands, in our opinion, second only to Watson, the "Macaulay of Medicine;" he possesses that happy faculty of clothing instruction in easy garments; combining pleasure with profit, he leads his pupils, in spite of the ancient proverb, along a royal road to learning. His work is one which will not satisfy the extreme on either side, but it is one that will please the great majority who are seeking truth, and one that will convince the student that he has committed himself to a candid, safe, and valuable guide.—*N. A. Med.-Chirurg Review.*

We have to say of it, briefly and decidedly, that it is the best work on the subject in any language, and that it stamps Dr. West as the *facile princeps* of British obstetric authors.—*Edinburgh Med. Journal.*

BARNES (ROBERT), M.D., F.R.C.P.,
Obstetric Physician to St. Thomas's Hospital, &c.

A CLINICAL EXPOSITION OF THE MEDICAL AND SURGICAL DISEASES OF WOMEN. In one handsome octavo volume of about 800 pages, with 169 illustrations. Cloth, $5 00; leather, $6 00. (*Just Ready.*)

The very complete scope of this volume and the manner in which it has been filled out, may be seen by the subjoined Summary of Contents.

INTRODUCTION. CHAPTER I. Ovaries; Corpus Luteum. II. Fallopian Tubes. III. Shape of Uterine Cavity. IV. Structure of Uterus. V. The Vagina. VI. Examinations and Diagnosis. VII. Significance of Leucorrhœa. VIII. Discharges of Air. IX. Watery Discharges. X. Purulent Discharges. XI. Hemorrhagic Discharges. XII. Significance of Pain. XIII. Significance of Dyspareunia. XIV. Significance of Sterility. XV. Instrumental Diagnosis and Treatment. XVI. Diagnosis by the Touch, the Sound, the Speculum. XVII. Menstruation and its Disorders. XVIII. Amenorrhœa. XIX. Amenorrhœa (continued). XX. Dysmenorrhœa. XXI. Ovarian Dysmenorrhœa, &c. XXII. Inflammatory Dysmenorrhœa. XXIII. Irregularities of Change of Life. XXIV. Relations between Menstruation and Diseases. XXV. Disorders of Old Age. XXVI. Ovary, Absence and Hernia of. XXVII. Ovary, Hemorrhage, &c., of. XXVIII. Ovary, Tubercle, Cancer, &c., of. XXIX. Ovarian Cystic Tumors. XXX. Dermoid Cysts of Ovary. XXXI. Ovarian Tumors, Prognosis of. XXXII. Diagnosis of Ovarian Tumors. XXXIII. Ovarian Cysts, Treatment of. XXXIV. Fallopian Tubes, Diseases of. XXXV. Broad Ligaments, Diseases of. XXXVI. Extra-uterine Gestation. XXXVII. Special Pathology of Uterus. XXXVIII. General Uterine Pathology. XXXIX. Alterations of Blood Supply. XL. Metritis, Endometritis, &c. XLI. Pelvic Cellulitis and Peritonitis, &c. XLII. Hæmatocele, &c. XLIII. Displacements of Uterus. XLIV. Displacements (continued). XLV. Retroversion and Retroflexion. XLVI. Inversion. XLVII. Uterine Tumors. XLVIII. Polypus Uteri. XLIX. Polypus Uteri (continued). L. Cancer. LI. Diseases of Vagina. LII. Diseases of the Vulva.

Embodying the long experience and personal observation of one of the greatest of living teachers in diseases of women, it seems pervaded by the presence of the author, who speaks directly to the reader, and speaks, too, as one having authority. And yet, notwithstanding this distinct personality, there is nothing narrow as to time, place, or individuals, in the views presented, and in the instructions given; Dr. Barnes has been an attentive student, not only of European, but also of American literature, pertaining to diseases of females, and enriched his own experience by treasures thence gathered; he seems as familiar, for example, with the writings of Sims, Emmet, Thomas, and Peaslee, as if these eminent men were his countrymen and colleagues, and gives them a credit which must be gratifying to every American physician.—*Am. Journ. Med. Sci.*, April, 1874.

Throughout the whole book it is impossible not to feel that the author has spontaneously, conscientiously, and fearlessly performed his task. He goes direct to the point, and does not loiter on the way to gossip or quarrel with other authors. Dr. Barnes's book will be eagerly read all over the world, and will everywhere be admired for its comprehensiveness, honesty of purpose, and ability.—*The Obstet. Journ. of Great Britain and Ireland*, March, 1874.

CHURCHILL ON THE PUERPERAL FEVER AND OTHER DISEASES PECULIAR TO WOMEN. 1 vol. 8vo., pp. 450, cloth. $2 50.

MEIGS ON WOMAN: HER DISEASES AND THEIR REMEDIES. A Series of Lectures to his Class. Fourth and Improved Edition. 1 vol. 8vo., over 700 pages, cloth, $5 00; leather, $6 00.

MEIGS ON THE NATURE, SIGNS, AND TREATMENT OF CHILDBED FEVER. 1 vol. 8vo., pp. 865, cloth. $2 00.

ASHWELL'S PRACTICAL TREATISE ON THE DISEASES PECULIAR TO WOMEN. Third American, from the Third and revised London edition. 1 vol. 8vo., pp. 528, cloth. $3 50.

DEWEES'S TREATISE ON THE DISEASES OF FEMALES. With illustrations. Eleventh Edition, with the Author's last improvements and corrections. In one octavo volume of 536 pages, with plates, cloth. $3 00.

HODGE (HUGH L.), M. D.,

Emeritus Professor of Midwifery, &c., in the University of Pennsylvania, &c.

THE PRINCIPLES AND PRACTICE OF OBSTETRICS. Illustrated with large lithographic plates containing one hundred and fifty-nine figures from original photographs, and with numerous wood-cuts. In one large and beautifully printed quarto volume of 550 double-columned pages, strongly bound in cloth, $14.

The work of Dr. Hodge is something more than a simple presentation of his particular views in the department of Obstetrics; it is something more than an ordinary treatise on midwifery; it is, in fact, a cyclopædia of midwifery. He has aimed to embody in a single volume the whole science and art of Obstetrics. An elaborate text is combined with accurate and varied pictorial illustrations, so that no fact or principle is left unstated or unexplained.—*Am. Med. Times*, Sept. 3, 1864.

We should like to analyze the remainder of this excellent work, but already has this review extended beyond our limited space. We cannot conclude this notice without referring to the excellent finish of the work. In typography it is not to be excelled; the paper is superior to what is usually afforded by our American cousins, quite equal to the best of English books. The engravings and lithographs are most beautifully executed. The work recommends itself for its originality, and is in every way a most valuable addition to those on the subject of obstetrics.—*Canada Med. Journal*, Oct. 1864

It is very large, profusely and elegantly illustrated, and is fitted to take its place near the works of great obstetricians. Of the American works on the subject it is decidedly the best.—*Edinb. Med. Jour.*, Dec. '64.

We have examined Professor Hodge's work with great satisfaction; every topic is elaborated most fully. The views of the author are comprehensive, and concisely stated. The rules of practice are judicious, and will enable the practitioner to meet every emergency of obstetric complication with confidence. —*Chicago Med. Journal*, Aug. 1864.

More time than we have had at our disposal since we received the great work of Dr. Hodge is necessary to do it justice. It is undoubtedly by far the most original, complete, and carefully composed treatise on the principles and practice of Obstetrics which has ever been issued from the American press.—*Pacific Med. and Surg. Journal*, July, 1864.

We have read Dr. Hodge's book with great pleasure, and have much satisfaction in expressing our commendation of it as a whole. It is certainly highly instructive, and in the main, we believe, correct. The great attention which the author has devoted to the mechanism of parturition, taken along with the conclusions at which he has arrived, point, we think, conclusively to the fact that, in Britain at least, the doctrines of Naegele have been too blindly received. —*Glasgow Med. Journal*, Oct. 1864.

*** Specimens of the plates and letter-press will be forwarded to any address, free by mail, on receipt of six cents in postage stamps.

TANNER (THOMAS H.), M. D.

ON THE SIGNS AND DISEASES OF PREGNANCY. First American from the Second and Enlarged English Edition. With four colored plates and illustrations on wood. In one handsome octavo volume of about 500 pages, cloth, $4 25.

The very thorough revision the work has undergone has added greatly to its practical value, and increased materially its efficiency as a guide to the student and to the young practitioner.—*Am. Journ. Med. Sci.*, April, 1868.

With the immense variety of subjects treated of and the ground which they are made to cover, the impossibility of giving an extended review of this truly remarkable work must be apparent. We have not a single fault to find with it, and most heartily commend it to the careful study of every physician who would not only always be sure of his diagnosis of pregnancy, but always ready to treat all the numerous ailments that are, unfortunately for the civilized women of to-day, so commonly associated with the function.—*N. Y. Med. Record*, March 16, 1868.

We recommend obstetrical students, young and old, to have this volume in their collections. It contains not only a fair statement of the signs, symptoms, and diseases of pregnancy, but comprises in addition much interesting relative matter that is not to be found in any other work that we can name.—*Edinburgh Med Journal*, Jan. 1868.

SWAYNE (JOSEPH GRIFFITHS), M. D.,

Physician-Accoucheur to the British General Hospital, &c.

OBSTETRIC APHORISMS FOR THE USE OF STUDENTS COMMENCING MIDWIFERY PRACTICE. Second American, from the Fifth and Revised London Edition, with Additions by E. R. HUTCHINS, M. D. With Illustrations. In one neat 12mo. volume. Cloth, $1 25. (*Lately Issued.*)

*** See p. 3 of this Catalogue for the terms on which this work is offered as a premium to subscribers to the "AMERICAN JOURNAL OF THE MEDICAL SCIENCES."

It is really a capital little compendium of the subject, and we recommend young practitioners to buy it and carry it with them when called to attend cases of labor. They can while away the otherwise tedious hours of waiting, and thoroughly fix in their memories the most important practical suggestions it contains. The American editor has materially added by his notes and the concluding chapters to the completeness and general value of the book.—*Chicago Med. Journal*, Feb. 1870.

The manual before us contains in exceedingly small compass—small enough to carry in the pocket—about all there is of obstetrics, condensed into a nutshell of Aphorisms. The illustrations are well selected, and serve as excellent reminders of the conduct of labor—regular and difficult.—*Cincinnati Lancet*, April, '70.

This is a most admirable little work, and completely answers the purpose. It is not only valuable for young beginners, but no one who is not a proficient in the art of obstetrics should be without it, because it condenses all that is necessary to know for ordinary midwifery practice. We commend the book most favorably.—*St. Louis Med. and Surg. Journal*, Sept. 10, 1870.

A studied perusal of this little book has satisfied us of its eminently practical value. The object of the work, the author says, in his preface, is to give the student a few brief and practical directions respecting the management of ordinary cases of labor; and also to point out to him in extraordinary cases when and how he may act upon his own responsibility, and when he ought to send for assistance.—*N. Y. Medical Journal*, May, 1870

WINCKEL (F.),

Professor and Director of the Gynæcological Clinic in the University of Rostock.

A COMPLETE TREATISE ON THE PATHOLOGY AND TREATMENT OF CHILDBED, for Students and Practitioners. Translated, with the consent of the author, from the Second German Edition, by JAMES READ CHADWICK, M D. In one octavo volume. (*Preparing.*)

LEISHMAN (*WILLIAM*), *M.D.*,

Regius Professor of Midwifery in the University of Glasgow, &c.

A SYSTEM OF MIDWIFERY, INCLUDING THE DISEASES OF PREGNANCY AND THE PUERPERAL STATE. In one large and very handsome octavo volume of over 700 pages, with one hundred and eighty-two illustrations. Cloth, $5 00; leather, $6 00. (*Just Issued*)

This is one of a most complete and exhaustive character. We have gone carefully through it, and there is no subject in Obstetrics which has not been considered well and fully. The result is a work, not only admirable as a text-book, but valuable as a work of reference to the practitioner in the various emergencies of obstetric practice. Take it all in all, we have no hesitation in saying that it is in our judgment the best English work on the subject.—*London Lancet*, Aug. 23, 1873.

The work of Leishman gives an excellent view of modern midwifery, and evinces its author's extensive acquaintance with British and foreign literature; and not only acquaintance with it, but wholesome digestion and sound judgment of it. He has, withal, a manly, free style, and can state a difficult and complicated matter with remarkable clearness and brevity. —*Edin. Med. Journ.*, Sept. 1873.

The author has succeeded in presenting to the profession an admirable treatise, especially in its practical aspects; one which is, in general, clearly written, and sound in doctrine, and one which cannot fail to add to his already high reputation. In concluding our examination of this work, we cannot avoid again saying that Dr. Leishman has fully accomplished that difficult task of presenting a good text-book upon obstetrics. We know none better for the use of the student or junior practitioner.—*Am. Practitioner*, Mar. 1874.

It proposes to offer to practitioners and students "A Complete System of the Midwifery of the Present Day," and well redeems the promise. In all that relates to the subject of labor, the teaching is admirably clear, concise, and practical, representing not alone British practice, but the contributions of Continental and American schools.—*N. Y. Med. Record*, March 2, 1874.

The work of Dr. Leishman is, in many respects, not only the best treatise on midwifery that we have seen, but one of the best treatises on any medical subject that has been published of late years.—*Lond. Practitioner*, Feb. 1874.

It was written to supply a desideratum, and we will be much surprised if it does not fulfil the purpose of its author. Taking it as a whole, we know of no work on obstetrics by an English author in which the student and the practitioner will find the information so clear and so completely abreast of the present state of our knowledge on the subject.—*Glasgow Med. Journ.*, Aug. 1873.

Dr. Leishman's System of Midwifery, which has only just been published, will go far to supply the want which has so long been felt, of a really good modern English text-book. Although large, as is inevitable in a work on so extensive a subject, it is so well and clearly written, that it is never wearisome to read. Dr. Leishman's work may be confidently recommended as an admirable text-book, and is sure to be largely used.—*Lond. Med. Record*, Sept. 1873.

RAMSBOTHAM (*FRANCIS H.*), *M.D.*

THE PRINCIPLES AND PRACTICE OF OBSTETRIC MEDICINE AND SURGERY, in reference to the Process of Parturition. A new and enlarged edition, thoroughly revised by the author. With additions by W. V. KEATING, M. D., Professor of Obstetrics, &c., in the Jefferson Medical College, Philadelphia. In one large and handsome imperial octavo volume of 650 pages, strongly bound in leather, with raised bands; with sixty-four beautiful plates, and numerous wood-cuts in the text, containing in all nearly 200 large and beautiful figures. $7 00.

We will only add that the student will learn from it all he need to know, and the practitioner will find it, as a book of reference, surpassed by none other.—*Stethoscope.*

The character and merits of Dr. Ramsbotham's work are so well known and thoroughly established, that comment is unnecessary and praise superfluous. The illustrations, which are numerous and accurate, are executed in the highest style of art. We cannot too highly recommend the work to our readers.—*St. Louis Med. and Surg. Journal.*

To the physician's library it is indispensable, while to the student, as a text-book, from which to extract the material for laying the foundation of an education on obstetrical science, it has no superior.—*Ohio Med. and Surg. Journal.*

When we call to mind the toil we underwent in acquiring a knowledge of this subject, we cannot but envy the student of the present day the aid which this work will afford him.—*Am. Jour. of the Med. Sciences.*

CHURCHILL (*FLEETWOOD*), *M.D.*, *M.R.I.A.*

ON THE THEORY AND PRACTICE OF MIDWIFERY. A new American from the fourth revised and enlarged London edition. With notes and additions by D. FRANCIS CONDIE, M. D., author of a "Practical Treatise on the Diseases of Children," &c. With one hundred and ninety-four illustrations. In one very handsome octavo volume of nearly 700 large pages. Cloth, $4 00; leather, $5 00.

These additions render the work still more complete and acceptable than ever; and we can commend it to the profession with great cordiality and pleasure.—*Cincinnati Lancet.*

Few works on this branch of medical science are equal to it, certainly none excel it, whether in regard to theory or practice—*Brit. Am. Journal.*

No treatise on obstetrics with which we are acquainted can compare favorably with this, in respect to the amount of material which has been gathered from every source.—*Boston Med. and Surg. Journal.*

There is no better text-book for students, or work of reference and study for the practising physician than this. It should adorn and enrich every medical library.—*Chicago Med. Journal.*

MONTGOMERY'S EXPOSITION OF THE SIGNS AND SYMPTOMS OF PREGNANCY. With two exquisite colored plates, and numerous wood-cuts. In 1 vol. 8vo., of nearly 600 pp., cloth. $3 75.

RIGBY'S SYSTEM OF MIDWIFERY. With Notes and Additional Illustrations. Second American edition. One volume octavo, cloth, 422 pages $2 50

GROSS (SAMUEL D.), M.D.,

Professor of Surgery in the Jefferson Medical College of Philadelphia.

A SYSTEM OF SURGERY: Pathological, Diagnostic, Therapeutic, and Operative.

Illustrated by upwards of Fourteen Hundred Engravings. Fifth edition, carefully revised, and improved. In two large and beautifully printed imperial octavo volumes of about 2300 pages, strongly bound in leather, with raised bands, $15. (*Just Issued.*)

The continued favor, shown by the exhaustion of successive large editions of this great work, proves that it has successfully supplied a want felt by American practitioners and students. In the present revision no pains have been spared by the author to bring it in every respect fully up to the day. To effect this a large part of the work has been rewritten, and the whole enlarged by nearly one-fourth, notwithstanding which the price has been kept at its former very moderate rate. By the use of a close, though very legible type, an unusually large amount of matter is condensed in its pages, the two volumes containing as much as four or five ordinary octavos. This, combined with the most careful mechanical execution, and its very durable binding, renders it one of the cheapest works accessible to the profession. Every subject properly belonging to the domain of surgery is treated in detail, so that the student who possesses this work may be said to have in it a surgical library. A few notices of the previous edition are subjoined:—

It must long remain the most comprehensive work on this important part of medicine.—*Boston Medical and Surgical Journal*, March 23, 1865.

We have compared it with most of our standard works, such as those of Erichsen, Miller, Fergusson, Syme, and others, and we must, in justice to our author, award it the pre-eminence. As a work, complete in almost every detail, no matter how minute or trifling, and embracing every subject known in the principles and practice of surgery, we believe it stands without a rival. Dr. Gross, in his preface, remarks "my aim has been to embrace the whole domain of surgery, and to allot to every subject its legitimate claim to notice;" and, we assure our readers, he has kept his word. It is a work which we can most confidently recommend to our brethren, for its utility is becoming the more evident the longer it is upon the shelves of our library.—*Canada Med. Journal*, September, 1865.

The first two editions of Professor Gross' System of Surgery are so well known to the profession, and so highly prized, that it would be idle for us to speak in praise of this work.—*Chicago Medical Journal*, September, 1865.

We gladly indorse the favorable recommendation of the work, both as regards matter and style, which we made when noticing its first appearance.—*British and Foreign Medico-Chirurgical Review*, Oct. 1865.

The most complete work that has yet issued from the press on the science and practice of surgery.—*London Lancet.*

This system of surgery is, we predict, destined to take a commanding position in our surgical literature, and be the crowning glory of the author's well earned fame. As an authority on general surgical subjects, this work is long to occupy a pre-eminent place, not only at home, but abroad. We have no hesitation in pronouncing it without a rival in our language, and equal to the best systems of surgery in any language.—*N. Y. Med. Journal.*

Not only by far the best text-book on the subject, as a whole, within the reach of American students, but one which will be much more than ever likely to be resorted to and regarded as a high authority abroad.—*Am. Journal Med. Sciences*, Jan. 1865.

The work contains everything, minor and major, operative and diagnostic, including mensuration and examination, venereal diseases, and uterine manipulations and operations. It is a complete Thesaurus of modern surgery, where the student and practitioner shall not seek in vain for what they desire.—*San Francisco Med. Press*, Jan. 1865.

Open it where we may, we find sound practical information conveyed in plain language. This book is no mere provincial or even national system of surgery, but a work which, while very largely indebted to the past, has a strong claim on the gratitude of the future of surgical science.—*Edinburgh Med. Journal*, Jan. 1865.

A glance at the work is sufficient to show that the author and publisher have spared no labor in making it the most complete "System of Surgery" ever published in any country.—*St. Louis Med. and Surg. Journal*, April, 1865.

A system of surgery which we think unrivalled in our language, and which will indelibly associate his name with surgical science. And what, in our opinion, enhances the value of the work is that, while the practising surgeon will find all that he requires in it, it is at the same time one of the most valuable treatises which can be put into the hands of the student seeking to know the principles and practice of this branch of the profession which he designs subsequently to follow.—*The Brit. Am. Journ., Montreal.*

BY THE SAME AUTHOR.

A PRACTICAL TREATISE ON FOREIGN BODIES IN THE AIR-PASSAGES.

In 1 vol. 8vo., with illustrations, pp. 468, cloth, $2 75.

SKEY'S OPERATIVE SURGERY. In 1 vol. 8vo. cloth, of over 650 pages; with about 100 wood-cuts. $3 25.

COOPER'S LECTURES ON THE PRINCIPLES AND PRACTICE OF SURGERY. In 1 vol. 8vo. cloth, 750 p. $2.

GIBSON'S INSTITUTES AND PRACTICE OF SURGERY. Eighth edition, improved and altered. With thirty-four plates. In two handsome octavo volumes, about 1000 pp., leather, raised bands. $6 50.

MILLER (JAMES),

Late Professor of Surgery in the University of Edinburgh, &c.

PRINCIPLES OF SURGERY.

Fourth American, from the third and revised Edinburgh edition. In one large and very beautiful volume of 700 pages, with two hundred and forty illustrations on wood, cloth, $3 75.

BY THE SAME AUTHOR.

THE PRACTICE OF SURGERY.

Fourth American, from the last Edinburgh edition. Revised by the American editor. Illustrated by three hundred and sixty-four engravings on wood. In one large octavo volume of nearly 700 pages, cloth, $3 75.

SARGENT (F. W.), M.D.

ON BANDAGING AND OTHER OPERATIONS OF MINOR SURGERY.

New edition, with an additional chapter on Military Surgery. One handsome royal 12mo. volume, of nearly 400 pages, with 184 wood-cuts. Cloth, $1 75.

ASHHURST (*JOHN, Jr.*), *M.D.*,

Surgeon to the Episcopal Hospital, Philadelphia.

THE PRINCIPLES AND PRACTICE OF SURGERY. In one very large and handsome octavo volume of about 1000 pages, with nearly 550 illustrations, cloth, $6 50; leather, raised bands, $7 50. (*Just Issued.*)

The object of the author has been to present, within as condensed a compass as possible, a complete treatise on Surgery in all its branches, suitable both as a text-book for the student and a work of reference for the practitioner. So much has of late years been done for the advancement of Surgical Art and Science, that there seemed to be a want of a work which should present the latest aspects of every subject, and which, by its American character, should render accessible to the profession at large the experience of the practitioners of both hemispheres. This has been the aim of the author, and it is hoped that the volume will be found to fulfil its purpose satisfactorily. The plan and general outline of the work will be seen by the annexed

CONDENSED SUMMARY OF CONTENTS.

CHAPTER I. Inflammation. II. Treatment of Inflammation. III. Operations in general: Anæsthetics. IV. Minor Surgery. V. Amputations. VI. Special Amputations. VII. Effects of Injuries in General: Wounds. VIII. Gunshot Wounds. IX. Injuries of Bloodvessels. X. Injuries of Nerves, Muscles and Tendons, Lymphatics, Bursæ, Bones, and Joints. XI. Fractures. XII. Special Fractures. XIII. Dislocations. XIV. Effects of Heat and Cold. XV. Injuries of the Head. XVI. Injuries of the Back. XVII. Injuries of the Face and Neck. XVIII. Injuries of the Chest. XIX. Injuries of the Abdomen and Pelvis. XX. Diseases resulting from Inflammation. XXI. Erysipelas. XXII. Pyæmia. XXIII. Diathetic Diseases: Struma (including Tubercle and Scrofula); Rickets. XXIV. Venereal Diseases; Gonorrhœa and Chancroid. XXV. Venereal Diseases continued: Syphilis. XXVI. Tumors. XXVII. Surgical Diseases of Skin, Areolar Tissue, Lymphatics, Muscles, Tendons, and Bursæ. XXVIII. Surgical Disease of Nervous System (including Tetanus). XXIX. Surgical Diseases of Vascular System (including Aneurism). XXX. Diseases of Bone. XXXI. Diseases of Joints. XXXII. Excisions. XXXIII. Orthopædic Surgery. XXXIV. Diseases of Head and Spine. XXXV. Diseases of the Eye. XXXVI. Diseases of the Ear. XXXVII. Diseases of the Face and Neck. XXXVIII. Diseases of the Mouth, Jaws, and Throat. XXXIX. Diseases of the Breast. XL. Hernia. XLI. Special Herniæ. XLII. Diseases of Intestinal Canal. XLIII. Diseases of Abdominal Organs, and various operations on the Abdomen. XLIV. Urinary Calculus. XLV. Diseases of Bladder and Prostate. XLVI. Diseases of Urethra. XLVII. Diseases of Generative Organs. INDEX.

Its author has evidently tested the writings and experiences of the past and present in the crucible of a careful, analytic, and honorable mind, and faithfully endeavored to bring his work up to the level of the highest standard of practical surgery. He is frank and definite, and gives us opinions, and generally sound ones, instead of a mere *résumé* of the opinions of others He is conservative, but not hidebound by authority. His style is clear, elegant, and scholarly. The work is an admirable text-tbook, and a useful book of reference It is a credit to American professional literature, and one of the first ripe fruits of the soil fertilized by the blood of our late unhappy war.—*N. Y. Med. Record*, Feb. 1, 1872.

Indeed, the work as a whole must be regarded as an excellent and concise exponent of modern surgery, and as such it will be found a valuable text-book for the student, and a useful book of reference for the general practitioner.—*N. Y. Med. Journal*, Feb. 1872.

It gives us great pleasure to call the attention of the profession to this excellent work. Our knowledge of its talented and accomplished author led us to expect from him a very valuable treatise upon subjects to which he has repeatedly given evidence of having profitably devoted much time and labor, and we are in no way disappointed.—*Phila. Med. Times*, Feb. 1, 1872.

PIRRIE (*WILLIAM*), *F. R. S. E.*,

Professor of Surgery in the University of Aberdeen.

THE PRINCIPLES AND PRACTICE OF SURGERY. Edited by JOHN NEILL, M. D., Professor of Surgery in the Penna. Medical College, Surgeon to the Pennsylvania Hospital, &c. In one very handsome octavo volume of 780 pages, with 316 illustrations, cloth, $3 75.

HAMILTON (*FRANK H.*), *M.D.*,

Professor of Fractures and Dislocations, &c., in Bellevue Hosp. Med. College, New York.

A PRACTICAL TREATISE ON FRACTURES AND DISLOCATIONS. Fourth edition, thoroughly revised. In one large and handsome octavo volume of nearly 800 pages, with several hundred illustrations. Cloth, $5 75; leather, $6 75. (*Just Issued.*)

It is not, of course, our intention to review *in extenso*, Hamilton on "Fractures and Dislocations." Eleven years ago such review might not have been out of place; to-day the work is an authority, so well, so generally, and so favorably known, that it only remains for the reviewer to say that a new edition is just out, and it is better than either of its predecessors.—*Cincinnati Clinic*, Oct. 14, 1871.

Undoubtedly the best work on Fractures and Dislocations in the English language.—*Cincinnati Med. Repertory*, Oct. 1871.

We have once more before us Dr. Hamilton's admirable treatise, which we have always considered the most complete and reliable work on the subject. As a whole, the work is without an equal in the literature of the profession.—*Boston Med. and Surg. Journ.*, Oct. 12, 1871.

It is unnecessary at this time to commend the book, except to such as are beginners in the study of this particular branch of surgery. Every practical surgeon in this country and abroad knows of it as a most trustworthy guide, and one which they, in common with us, would unqualifiedly recommend as the highest authority in any language.—*N. Y. Med. Record* Oct. 16, 1871.

ERICHSEN (JOHN E.),
Professor of Surgery in University College, London, etc.

THE SCIENCE AND ART OF SURGERY; being a Treatise on Surgical Injuries, Diseases, and Operations. Revised by the author from the Sixth and enlarged English Edition. Illustrated by over seven hundred engravings on wood. In two large and beautiful octavo volumes of over 1700 pages, cloth, $9 00; leather, $11 00. (*Lately Issued.*)

Author's Preface to the New American Edition.

"The favorable reception with which the 'Science and Art of Surgery' has been honored by the Surgical Profession in the United States of America has been not only a source of deep gratification and of just pride to me, but has laid the foundation of many professional friendships that are amongst the agreeable and valued recollections of my life.

"I have endeavored to make the present edition of this work more deserving than its predecessors of the favor that has been accorded to them. In consequence of delays that have unavoidably occurred in the publication of the Sixth British Edition, time has been afforded to me to add to this one several paragraphs which I trust will be found to increase the practical value of the work."

LONDON, Oct. 1872.

On no former edition of this work has the author bestowed more pains to render it a complete and satisfactory exposition of British Surgery in its modern aspects. Every portion has been sedulously revised, and a large number of new illustrations have been introduced. In addition to the material thus added to the English edition, the author has furnished for the American edition such material as has accumulated since the passage of the sheets through the press in London, so that the work as now presented to the American profession, contains his latest views and experience.

The increase in the size of the work has seemed to render necessary its division into two volumes. Great care has been exercised in its typographical execution, and it is confidently presented as in every respect worthy to maintain the high reputation which has rendered it a standard authority on this department of medical science.

These are only a few of the points in which the present edition of Mr. Erichsen's work surpasses its predecessors. Throughout there is evidence of a laborious care and solicitude in seizing the passing knowledge of the day, which reflects the greatest credit on the author, and much enhances the value of his work. We can only admire the industry which has enabled Mr. Erichsen thus to succeed, amid the distractions of active practice, in producing emphatically THE book of reference and study for British practitioners of surgery.—*London Lancet*, Oct. 26, 1872.

Considerable changes have been made in this edition, and nearly a hundred new illustrations have been added. It is difficult in a small compass to point out the alterations and additions; for, as the author states in his preface, they are not confined to any one portion, but are distributed generally through the subjects of which the work treats. Certainly one of the most valuable sections of the book seems to us to be that which treats of the diseases of the arteries and the operative proceedings which they necessitate In few text-books is so much carefully arranged information collected.—*London Med. Times and Gaz.*, Oct. 26, 1872.

The entire work, complete, as the great English treatise on Surgery of our own time, is, we can assure our readers, equally well adapted for the most junior student, and, as a book of reference, for the advanced practitioner —*Dublin Quarterly Journal.*

DRUITT (ROBERT), M.R.C.S., &c.

THE PRINCIPLES AND PRACTICE OF MODERN SURGERY. A new and revised American, from the eighth enlarged and improved London edition. Illustrated with four hundred and thirty-two wood engravings. In one very handsome octavo volume, of nearly 700 large and closely printed pages, cloth, $4 00; leather, $5 00.

All that the surgical student or practitioner could desire.—*Dublin Quarterly Journal.*

It is a most admirable book. We do not know when we have examined one with more pleasure.—*Boston Med. and Surg. Journal.*

In Mr. Druitt's book, though containing only some seven hundred pages, both the principles and the practice of surgery are treated, and so clearly and perspicuously, as to elucidate every important topic. We have examined the book most thoroughly, and can say that this success is well merited. His book, moreover, possesses the inestimable advantages of having the subjects perfectly well arranged and classified, and of being written in a style at once clear and succinct.—*Am. Journal of Med. Sciences.*

ASHTON (T. J.).

ON THE DISEASES, INJURIES, AND MALFORMATIONS OF THE RECTUM AND ANUS; with remarks on Habitual Constipation. Second American, from the fourth and enlarged London edition. With handsome illustrations. In one very beautifully printed octavo volume of about 300 pages, cloth, $3 25.

BIGELOW (HENRY J.), M. D.,
Professor of Surgery in the Massachusetts Med. College.

ON THE MECHANISM OF DISLOCATION AND FRACTURE OF THE HIP. With the Reduction of the Dislocation by the Flexion Method. With numerous original illustrations. In one very handsome octavo volume. Cloth, $2 50. (*Lately Issued.*)

LAWSON (GEORGE), F. R. C. S., Engl.,
Assistant Surgeon to the Royal London Ophthalmic Hospital, Moorfields, &c.

INJURIES OF THE EYE, ORBIT, AND EYELIDS: their Immediate and Remote Effects. With about one hundred illustrations. In one very handsome octavo volume, cloth, $3 50

It is an admirable practical book in the highest and best sense of the phrase.—*London Medical Times and Gazette*, May 18, 1867.

BRYANT (THOMAS), F.R.C.S.,
Surgeon to Guy's Hospital.

THE PRACTICE OF SURGERY. With over Five Hundred Engravings on Wood.

In one large and very handsome octavo volume of nearly 1000 pages, cloth, $6 25; leather, raised bands, $7 25. (*Just Issued.*)

Again, the author gives us his own practice, his own beliefs, and illustrates by his own cases, or those treated in Guy's Hospital. This feature adds joint emphasis, and a solidity to his statements that inspire confidence. One feels himself almost by the side of the surgeon, seeing his work and hearing his living words. The views, etc, of other surgeons are considered calmly and fairly, but Mr. Bryant's are adopted. Thus the work is not a compilation of other writings; it is not an encyclopædia, but the plain statements, on practical points, of a man who has lived and breathed and had his being in the richest surgical experience. The whole profession owe a debt of gratitude to Mr. Bryant, for his work in their behalf. We are confident that the American profession will give substantial testimonial of their feelings towards both author and publisher, by speedily exhausting this edition. We cordially and heartily commend it to our friends, and think that no live surgeon can afford to be without it.—*Detroit Review of Med. and Pharmacy*, August, 1873.

As a manual of the practice of surgery for the use of the student, we do not hesitate to pronounce Mr. Bryant's book a first-rate work. Mr. Bryant has a good deal of the dogmatic energy which goes with the clear, pronounced opinions of a man whose reflections and experience have moulded a character not wanting in firmness and decision. At the same time he teaches with the enthusiasm of one who has faith in his teaching; he speaks as one having authority, and herein lies the charm and excellence of his work. He states the opinions of others freely and fairly, yet it is no mere compilation. The book combines much of the merit of the manual with the merit of the monograph. One may recognize in almost every chapter of the ninety-four of which the work is made up the acuteness of a surgeon who has seen much, and observed closely, and who gives forth the results of actual experience. In conclusion we repeat what we stated at first, that Mr. Bryant's book is one which we can conscientiously recommend both to practitioners and students as an admirable work. —*Dublin Journ. of Med. Science*, August, 1873.

Mr. Bryant has long been known to the reading portion of the profession as an able, clear, and graphic writer upon surgical subjects. The volume before us is one eminently upon the practice of surgery and not one which treats at length on surgical pathology, though the views that are entertained upon this subject are sufficiently interspersed through the work for all practical purposes. As a text-book we cheerfully recommend it, feeling convinced that, from the subject-matter, and the concise and true way Mr. Bryant deals with his subject, it will prove a formidable rival among the numerous surgical text-books which are offered to the student.—*N. Y. Med. Record*, June, 1873.

This is, as the preface states, an entirely new book, and contains in a moderately condensed form all the surgical information necessary to a general practitioner. It is written in a spirit consistent with the present improved standard of medical and surgical science.—*American Journal of Obstetrics*, August, 1873.

WELLS (J. SOELBERG),
Professor of Ophthalmology in King's College Hospital, &c.

A TREATISE ON DISEASES OF THE EYE. Second American,

from the Third and Revised London Edition, with additions; illustrated with numerous engravings on wood, and six colored plates. Together with selections from the Test-types of Jaeger and Snellen. In one large and very handsome octavo volume of nearly 800 pages; cloth, $5 00; leather, $6 00. (*Now Ready.*)

The continued demand for this work, both in England and this country, is sufficient evidence that the author has succeeded in his effort to supply within a reasonable compass a full practical digest of ophthalmology in its most modern aspects, while the call for repeated editions has enabled him in his revisions to maintain its position abreast of the most recent investigations and improvements. In again reprinting it, every effort has been made to adapt it thoroughly to the wants of the American practitioner. Such additions as seemed desirable have been introduced by the editor, Dr. I. Minis Hays, and the number of illustrations has been largely increased. The importance of test-types as an aid to diagnosis is so universally acknowledged at the present day that it seemed essential to the completeness of the work that they should be added, and as the author recommends the use of those both of Jaeger and of Snellen for different purposes, selections have been made from each, so that the practitioner may have at command all the assistance necessary. Although enlarged by one hundred pages, it has been retained at the former very moderate price, rendering it one of the cheapest volumes before the profession.

A few notices of the previous edition are subjoined.

In this respect the work before us is of much more service to the general practitioner than those heavy compilations which, in giving every person's views, too often neglect to specify those which are most in accordance with the author's opinions, or in general acceptance. We have no hesitation in recommending this treatise, as, on the whole, of all English works on the subject, the one best adapted to the wants of the general practitioner.—*Edinburgh Med. Journal*, March, 1870.

A treatise of rare merit. It is practical, comprehensive, and yet concise. Upon those subjects usually found difficult to the student, he has dwelt at length and entered into full explanation. After a careful perusal of its contents, we can unhesitatingly commend it to all who desire to consult a really good work on ophthalmic science.—*Leavenworth Med. Herald*, Jan. 1870.

Without doubt, one of the best works upon the subject which has ever been published; it is complete on the subject of which it treats, and is a necessary work for every physician who attempts to treat diseases of the eye.—*Dominion Med. Journal*, Sept. 1869.

LAURENCE (JOHN Z.), F. R. C. S.,
Editor of the Ophthalmic Review, &c.

A HANDY-BOOK OF OPHTHALMIC SURGERY, for the use of Practitioners.

Second Edition, revised and enlarged. With numerous illustrations. In one very handsome octavo volume, cloth, $3 00. (*Lately Issued.*)

For those, however, who must assume the care of diseases and injuries of the eye, and who are too much pressed for time to study the classic works on the subject, or those recently published by Stellwag, Wells, Bader, and others, Mr. Laurence will prove a safe and trustworthy guide. He has described in this edition those novelties which have secured the confidence of the profession since the appearance of his last. The volume has been considerably enlarged and improved by the revision and additions of its author, expressly for the American edition.—*Am. Journ. Med. Sciences*, Jan. 1870.

THOMPSON (SIR HENRY),
Surgeon and Professor of Clinical Surgery to University College Hospital.

LECTURES ON DISEASES OF THE URINARY ORGANS. With illustrations on wood. Second American from the Third English Edition. In one neat octavo volume. (*Nearly Ready.*)

These lectures stand the severe test. They are instructive without being tedious, and simple without being diffuse; and they include many of those practical hints so useful for the student, and even more valuable to the young practitioner.—*Edinburgh Med. Journal*, April, 1869.

BY THE SAME AUTHOR.

ON THE PATHOLOGY AND TREATMENT OF STRICTURE OF THE URETHRA AND URINARY FISTULÆ. With plates and wood-cuts. From the third and revised English edition. In one very handsome octavo volume, cloth, $3 50. (*Lately Published.*)

This classical work has so long been recognized as a standard authority on its perplexing subjects that it should be rendered accessible to the American profession. Having enjoyed the advantage of a revision at the hands of the author within a few months, it will be found to present his latest views and to be on a level with the most recent advances of surgical science.

With a work accepted as *the* authority upon the subjects of which it treats, an extended notice would be a work of supererogation. The simple announcement of another edition of a work so well and favorably known by the profession as this before us, must create a demand for it from those who would keep themselves well up in this department of surgery.—*St. Louis Med. Archives*, Feb. 1870.

BY THE SAME AUTHOR. (*Just Issued.*)

THE DISEASES OF THE PROSTATE, THEIR PATHOLOGY AND TREATMENT. Fourth Edition, Revised. In one very handsome octavo volume of 355 pages, with thirteen plates, plain and colored, and illustrations on wood. Cloth, $3 75.

This work is recognized in England as the leading authority on its subject, and in presenting it to the American profession, it is hoped that it will be found a trustworthy and satisfactory guide in the treatment of an obscure and important class of affections.

WALES (PHILIP S.), M. D., Surgeon U. S. N.

MECHANICAL THERAPEUTICS: a Practical Treatise on Surgical Apparatus, Appliances, and Elementary Operations: embracing Minor Surgery, Bandaging, Orthopraxy, and the Treatment of Fractures and Dislocations. With six hundred and forty-two illustrations on wood. In one large and handsome octavo volume of about 700 pages: cloth, $5 75; leather, $6 75.

TAYLOR (ALFRED S.), M.D.,
Lecturer on Med. Jurisp. and Chemistry in Guy's Hospital

MEDICAL JURISPRUDENCE. Seventh American Edition. Edited by JOHN J. REESE, M.D., Prof. of Med. Jurisp. in the Univ. of Penn. In one large octavo volume of nearly 900 pages. Cloth, $5 00; leather, $6 00. (*Now Ready.*)

In preparing for the press this *seventh* American edition of the "Manual of Medical Jurisprudence" the editor has, through the courtesy of Dr. Taylor, enjoyed the very great advantage of consulting the sheets of the new edition of the author's larger work, "The Principles and Practice of Medical Jurisprudence," which is now ready for publication in London. This has enabled him to introduce the author's latest views upon the topics discussed, which are believed to bring the work fully up to the present time.

The notes of the former editor, Dr. Hartshorne, as also the numerous valuable references to American practice and decisions by his successor, Mr. Penrose, have been retained, with but few slight exceptions; they will be found inclosed in brackets, distinguished by the letters (H.) and (P.). The additions made by the present editor, from the material at his command, amount to about one hundred pages; and his own notes are designated by the letter (R.).

Several subjects, not treated of in the former edition, have been noticed in the present one, and the work, it is hoped, will be found to merit a continuance of the confidence which it has so long enjoyed as a standard authority.

BY THE SAME AUTHOR. (*Now Ready.*)

THE PRINCIPLES AND PRACTICE OF MEDICAL JURISPRUDENCE. Second Edition, Revised, with numerous Illustrations. In two very large octavo volumes, cloth, $10 00; leather, $12 00.

This great work is now recognized in England as the fullest and most authoritative treatise on every department of its important subject. In laying it, in its improved form, before the American profession, the publisher trusts that it will assume the same position in this country.

TUKE (*DANIEL HACK*), *M.D.*,
Joint author of "The Manual of Psychological Medicine," &c.

ILLUSTRATIONS OF THE INFLUENCE OF THE MIND UPON THE BODY IN HEALTH AND DISEASE. Designed to illustrate the Action of the Imagination. In one handsome octavo volume of 416 pages, cloth, $3 25. (*Just Issued.*)

The object of the author in this work has been to show not only the effect of the mind in causing and intensifying disease, but also its curative influence, and the use which may be made of the imagination and the emotions as therapeutic agents. Scattered facts bearing upon this subject have long been familiar to the profession, but no attempt has hitherto been made to collect and systematize them so as to render them available to the practitioner, by establishing the several phenomena upon a scientific basis. In the endeavor thus to convert to the use of legitimate medicine the means which have been employed so successfully in many systems of quackery, the author has produced a work of the highest freshness and interest as well as of permanent value.

BLANDFORD (*G. FIELDING*), *M. D., F. R. C P.*,
Lecturer on Psychological Medicine at the School of St. George's Hospital, &c.

INSANITY AND ITS TREATMENT: Lectures on the Treatment, Medical and Legal, of Insane Patients. With a Summary of the Laws in force in the United States on the Confinement of the Insane. By ISAAC RAY, M. D. In one very handsome octavo volume of 471 pages; cloth, $3 25. (*Just Issued.*)

This volume is presented to meet the want, so frequently expressed, of a comprehensive treatise, in moderate compass, on the pathology, diagnosis, and treatment of insanity. To render it of more value to the practitioner in this country, Dr. Ray has added an appendix which affords information, not elsewhere to be found in so accessible a form, to physicians who may at any moment be called upon to take action in relation to patients.

It satisfies a want which must have been sorely felt by the busy general practitioners of this country. It takes the form of a manual of clinical description of the various forms of insanity, with a description of the mode of examining persons suspected of insanity. We call particular attention to this feature of the book, as giving it a unique value to the general practitioner. If we pass from theoretical considerations to descriptions of the varieties of insanity as actually seen in practice and the appropriate treatment for them, we find in Dr. Blandford's work a considerable advance over previous writings on the subject. His pictures of the various forms of mental disease are so clear and good that no reader can fail to be struck with their superiority to those given in ordinary manuals in the English language or (so far as our own reading extends) in any other.—*London Practitioner*, Feb. 1871.

WINSLOW (*FORBES*), *M.D., D.C.L., &c.*

ON OBSCURE DISEASES OF THE BRAIN AND DISORDERS OF THE MIND; their incipient Symptoms, Pathology, Diagnosis, Treatment, and Prophylaxis. Second American, from the third and revised English edition. In one handsome octavo volume of nearly 600 pages, cloth, $4 25.

LEA (*HENRY C.*).

SUPERSTITION AND FORCE: ESSAYS ON THE WAGER OF LAW, THE WAGER OF BATTLE, THE ORDEAL, AND TORTURE. Second Edition, Enlarged. In one handsome volume royal 12mo. of nearly 500 pages; cloth, $2 75. (*Lately Published.*)

We know of no single work which contains, in so small a compass, so much illustrative of the strangest operations of the human mind. Foot-notes give the authority for each statement, showing vast research and wonderful industry. We advise our *confrères* to read this book and ponder its teachings.—*Chicago Med. Journal*, Aug. 1870.

As a work of curious inquiry on certain outlying points of obsolete law, "Superstition and Force" is one of the most remarkable books we have met with. —*London Athenæum*, Nov. 3, 1866.

He has thrown a great deal of light upon what must be regarded as one of the most instructive as well as interesting phases of human society and progress. . . The fulness and breadth with which he has carried out his comparative survey of this repulsive field of history [Torture], are such as to preclude our doing justice to the work within our present limits. But here, as throughout the volume, there will be found a wealth of illustration and a critical grasp of the philosophical import of facts which will render Mr. Lea's labors of sterling value to the historical student.—*London Saturday Review*, Oct. 8, 1870.

As a book of ready reference on the subject, it is of the highest value.—*Westminster Review*, Oct. 1867.

BY THE SAME AUTHOR. (*Lately Published.*)

STUDIES IN CHURCH HISTORY—THE RISE OF THE TEMPORAL POWER—BENEFIT OF CLERGY—EXCOMMUNICATION. In one large royal 12mo. volume of 516 pp. cloth, $2 75.

The story was never told more calmly or with greater learning or wiser thought. We doubt, indeed, if any other study of this field can be compared with this for clearness, accuracy, and power.—*Chicago Examiner*, Dec. 1870.

Mr. Lea's latest work, "Studies in Church History," fully sustains the promise of the first. It deals with three subjects—the Temporal Power, Benefit of Clergy, and Excommunication, the record of which has a peculiar importance for the English student, and is a chapter on Ancient Law likely to be regarded as final. We can hardly pass from our mention of such works as these—with which that on "Sacerdotal Celibacy" should be included—without noting the literary phenomenon that the head of one of the first American houses is also the writer of some of its most original books.—*London Athenæum*, Jan. 7, 1871.

Mr. Lea has done great honor to himself and this country by the admirable works he has written on ecclesiological and cognate subjects. We have already had occasion to commend his "Superstition and Force" and his "History of Sacerdotal Celibacy." The present volume is fully as admirable in its method of dealing with topics and in the thoroughness—a quality so frequently lacking in American authors—with which they are investigated.—*N. Y. Journal of Psychol. Medicine*, July, 1870.

INDEX TO CATALOGUE.

	PAGE
American Journal of the Medical Sciences	1
Abstract, Half-Yearly, of the Med. Sciences	3
Anatomical Atlas, by Smith and Horner	6
Anderson on Diseases of the Skin	20
Ashton on the Rectum and Anus	28
Attfield's Chemistry	10
Ashwell on Diseases of Females	23
Ashhurst's Surgery	27
Barnes on Diseases of Women	23
Bellamy's Surgical Anatomy	7
Bryant's Practical Surgery	29
Bloxam's Chemistry	11
Blandford on Insanity	31
Basham on Renal Diseases	18
Brinton on the Stomach	16
Bigelow on the Hip	28
Barlow's Practice of Medicine	14
Bowman's (John E.) Practical Chemistry	11
Bowman's (John E.) Medical Chemistry	11
Bumstead on Venereal	19
Bumstead and Cullerier's Atlas of Venereal	19
Carpenter's Human Physiology	8
Carpenter's Comparative Physiology	8
Carpenter on the Use and Abuse of Alcohol	13
Carson's Synopsis of Materia Medica	13
Chambers on Diet and Regimen	16
Chambers on the Indigestions	16
Chambers's Restorative Medicine	16
Christison and Griffith's Dispensatory	13
Churchill's System of Midwifery	25
Churchill on Puerperal Fever	23
Condie on Diseases of Children	21
Cooper's (B. B.) Lectures on Surgery	26
Cullerier's Atlas of Venereal Diseases	19
Cyclopedia of Practical Medicine	15
Dalton's Human Physiology	9
Davis' Clinical Lectures	14
De Jongh on Cod-Liver Oil	13
Dewees on Diseases of Females	23
Dewees on Diseases of Children	20
Druitt's Modern Surgery	28
Dunglison's Medical Dictionary	4
Dunglison's Human Physiology	9
Dunglison on New Remedies	13
Ellis's Medical Formulary, by Smith	13
Erichsen's System of Surgery	28
Fenwick's Diagnosis	14
Flint on Respiratory Organs	17
Flint on the Heart	17
Flint's Practice of Medicine	15
Flint's Essays	15
Fownes's Elementary Chemistry	10
Fox on Diseases of the Stomach	16
Fuller on the Lungs, &c.	17
Green's Pathology and Morbid Anatomy	14
Gibson's Surgery	26
Gluge's Pathological Histology, by Leidy	14
Galloway's Qualitative Analysis	10
Gray's Anatomy	6
Griffith's (R. E.) Universal Formulary	13
Gross on Foreign Bodies in Air-Passages	26
Gross's Principles and Practice of Surgery	26
Gross's Pathological Anatomy	14
Guersant on Surgical Diseases of Children	20
Hamilton on Dislocations and Fractures	27
Hartshorne's Essentials of Medicine	16
Hartshorne's Conspectus of the Medical Sciences	5
Hartshorne's Anatomy and Physiology	7
Heath's Practical Anatomy	7
Hobbyn's Medical Dictionary	4
Hodge on Women	23
Hodge's Obstetrics	24
Horner's Practical Dissections	6
Holland's Medical Notes and Reflections	14
Horner's Anatomy and Histology	6
Hudson on Fevers	18
Hull on Venereal Diseases	19
Hillier's Handbook of Skin Diseases	20
Jones and Sieveking's Pathological Anatomy	14
Jones (C. Handfield) on Nervous Disorders	18
Kirkes' Physiology	8
Knapp's Chemical Technology	11
Lea's Superstition and Force	31
Lea's Studies in Church History	31
Lincoln on Electro Therapeutics	18
Leishman's Midwifery	25
La Roche on Yellow Fever	14
La Roche on Pneumonia, &c.	17
Laurence and Moon's Ophthalmic Surgery	29
Lawson on the Eye	28
Laycock on Medical Observation	14
Lehmann's Physiological Chemistry, 2 vols.	9
Lehmann's Chemical Physiology	9
Ludlow's Manual of Examinations	5
Lyons on Fever	18
Maclise's Surgical Anatomy	7
Marshall's Physiology	8
Medical News and Library	2
Meigs's Lectures on Diseases of Women	23
Meigs on Puerperal Fever	23
Miller's Practice of Surgery	26
Miller's Principles of Surgery	26
Montgomery on Pregnancy	25
Neill and Smith's Compendium of Med. Science	5
Neligan's Atlas of Diseases of the Skin	20
Neligan on Diseases of the Skin	20
Obstetrical Journal	22
Odling's Practical Chemistry	10
Pavy on Digestion	16
Pavy on Food	16
Parrish's Practical Pharmacy	12
Pirrie's System of Surgery	27
Pereira's Mat. Medica and Therapeutics, abridged	12
Quain and Sharpey's Anatomy, by Leidy	6
Roberts on Urinary Diseases	18
Ramsbotham on Parturition	25
Rigby's Midwifery	25
Royle's Materia Medica and Therapeutics	13
Swayne's Obstetric Aphorisms	24
Sargent's Minor Surgery	26
Sharpey and Quain's Anatomy, by Leidy	6
Skey's Operative Surgery	26
Slade on Diphtheria	18
Smith (J. L.) on Children	21
Smith (H. H.) and Horner's Anatomical Atlas	6
Smith (Edward) on Consumption	17
Smith on Wasting Diseases of Children	21
Stillé's Therapeutics	12
Sturges on Clinical Medicine	14
Stokes on Fever	14
Tanner's Manual of Clinical Medicine	5
Tanner on Pregnancy	24
Taylor's Medical Jurisprudence	30
Taylor's Principles and Practice of Med Jurisp.	30
Tuke on the Influence of the Mind	31
Thomas on Diseases of Females	22
Thompson on Urinary Organs	30
Thompson on Stricture	30
Thompson on the Prostate	30
Todd on Acute Diseases	14
Wales on Surgical Operations	30
Walshe on the Heart	17
Watson's Practice of Physic	15
Wells on the Eye	29
West on Diseases of Females	23
West on Diseases of Children	21
West on Nervous Disorders of Children	21
What to Observe in Medical Cases	14
Williams on Consumption	17
Wilson's Human Anatomy	7
Wilson on Diseases of the Skin	20
Wilson's Plates on Diseases of the Skin	20
Wilson's Handbook of Cutaneous Medicine	20
Winslow on Brain and Mind	31
Wöhler's Organic Chemistry	11
Winckel on Childbed	4
Zeissl on Venereal	19

For "THE OBSTETRICAL JOURNAL" FIVE DOLLARS a year, see p. 22